

Performance of Conventional and Shari'ah - Compliant Banks: A Data Envelopment Analysis Approach

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Authors' contributions

This work was carried out in collaboration between all authors. Author GMK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors TSTA and RB respectively managed the analyses of the study and provide the majority of the advice and support, author GMK needs to conduct the study. All authors read and approved the final manuscript.

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ABSTRACT

This study aims at examining the comparative performance of Islamic and conventional banks over the sample period from 2005 to 2016. The sample banks consist of a list of Islamic and conventional banks from twenty countries from Asia, Africa, the Middle East, Gulf region, and Europe. Banks performance is proxied by efficiency scores. The nonparametric Data Envelopment Analysis (DEA) is used to estimate the banks' relative efficiency scores. Additionally, the paper applies the two-sample *t*-test to compare whether the performance averages of the two types of banks are significantly different in the pre, during, and post crisis of 2008. Findings show that both Islamic and conventional banks appear to be on "average" technically inefficient. Inefficiencies are driven largely by the disproportionate size of operations. Poor management practices contribute partially to banks' inefficiency. Surprisingly, Islamic banks seem to

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have on “average” a significantly better and less volatile efficiency performance than conventional banks in the pre, crisis, and post-crisis periods. They, therefore, show better chances to improve efficiency by shrinking down activities to control costs and applying suitable changes to determining an appropriate input-output combination.

Keywords: Islamic banks; conventional banks; efficiency; DEA.

JEL Classification: G21, G01, G29, G39.

1. INTRODUCTION

Over the past years, Islamic banks’ financial transactions made up only a small part of less than 1 percent of the total traditional banking industry [1]. Nevertheless, due to its moral and spiritual values, Islamic finance has gradually gaining a global growth among Muslims and non-Muslims countries alike. Recently, Islamic banking is growing tremendously and Islamic banks have significantly expanded their financial operations into Muslim majority countries and most importantly into foreign countries to serve the international financial markets. It is estimated that the Islamic finance global total assets value has reached US\$ 2.432 trillion in 2017. Total Islamic finance assets are projected grow to reach US\$3.5 trillion in 2021. Islamic banking is the biggest contributor to the total value of Islamic finance assets. In 2017, Islamic banking’s share of Islamic finance assets was about US\$1.854 trillion. It is expected that Islamic banking sector will grow to reach US\$2,825 trillion in 2021 [2].

In spite of having observable tremendous growth in Islamic financial assets, Islamic finance industry is still relatively small as compared to the global financial industry [3]. Islamic financial assets are mainly concentrated in the Gulf Cooperation Council (GCC) countries as well as in Iran and Malaysia [4]. Therefore, there has been a question about Islamic banks’ sustainability and long-run ability to continue growing [5], particularly during the reverse market conditions [6]. Consequently, a reliable empirical examination and evaluation of Islamic banks’ versus conventional banks’ performance are essential within and outside Muslim majority countries. This study aims at examining the efficiency performance of Islamic banks against mainstream (conventional) banks in both Muslim-majority countries and around the world. The study then compares the performance of Islamic banks with each other in the same country and against conventional banks across countries.

Next section highlights the key characteristics of Islamic banking, which differentiate it from conventional banking.

1.1 A Basic Guide to Islamic Economics, Banking and Finance

The fundamental principles of Islamic ideology are the belief in the unity of the Creator- Allah (swt) (so called Tawhid), the prophethood (or Nubuwwa), and the ultimate return to the Creator for the final judgment [7]. These three axioms govern all of human’s actions and decisions. They encourage justice and fairness, support cooperation in socially beneficial activities and prohibit cooperation in harmful operations. In practice, justice is defined as acting in accordance with the Islamic Law (Shari’ah) [8]. In addition to the importance of the core relationship between people and the Creator (known as aqidah (faith)), what makes Islam different from other systems of thoughts is the fact that it prescribes a set of Shari’ah principles and rules for all human life aspects namely; social, economic, and financial. The Shari’ah principles are derived from the Qur’an and its operationalization by the Prophet Mohammad (pbuh). Shari’ah supports ethics (akhlaq) in social, political, and economic life (muamalat). Muamalat defines the conduct of activities within the economic system, which ultimately lays down the rules for financial and banking systems [7].

In addition to both the holy quran and hadith, Ijtihad is considered another source to derive rules for resolving issues arising in economics and finance. Ijtihad refers to the efforts of jurists and Muslim scholars to find solutions to problems that are not clearly addressed in the primary sources. Ijtihad is based on the earlier consensus of jurists (ijma’), analogy (qiyas), judicial preference (istihsan), public interest (maslahah) and customs (urf) [9].

Given the above discussion, Islam proposes a distinct economic and financial system. Islamic

economics and finance have the following distinguished principles [10]: The prohibition of interest (riba). Riba means literally "an excess". It is generally defined as the unjustified positive, fixed and predetermined increase of capital in sales and/or loans. Islam encourages profits (determined ex post) earning because it is symbolizing creative entrepreneurship and create additional wealth. In the contrary, interest (determined ex ante) is a cost that is accrued regardless of the outcome of business operations. In case of if their business losses, interest may not create wealth.

The second important principle of the Islamic economics and financial system is the "risk sharing" [9]. As interest is prohibited in Islam, debt securities are eliminated from the financial system and thus depositors "suppliers of funds" become investors, rather than creditors. Borrowers and lenders share rewards and/or losses in an equitable fashion. The prohibition of debt and the risk sharing principle leads to the third principle of Islamic finance. This principle suggests that all financial contracts are asset-based and fully backed by real sector assets and risk-sharing among partners. This indicates that the Islamic financial system links financing operations directly with the underlying assets to ensure the close relationship between financing activities and the real-sector activities.

The fourth principle is that money is only a medium of exchange and store of value. Money is not a commodity in which it has a price for its use. Money is "potential" capital. It becomes actual capital only when it is combined or used with other resources to undertake a productive activity. Therefore, the time value of money is recognized in Islam only when it acts as capital, not "potential" capital. Eventually, Islam prohibits speculative and gambling activities. These activities and transactions include a clear and excessive uncertainty (gharar), which occurs when either party to a contract has information regarding the subject of the contract.

The economic activities in any economic system are generally viewed as contracts between different agents in an economy. A financial instrument is also a contract, whose terms and conditions define the risk - and - return profile of the instrument. If a financial contract does not involve any of the prohibited elements mentioned above, it is thus considered islamically valid. The Islamic financial system has a set of core contracts. These contracts are classified into

three main types; transactional contracts, financing contracts, and intermediation contracts [7]. Transaction contracts include for example 1) Bay' al - salam (sale by immediate payment against future delivery. 2) Bay' al - istisnah (sale on order) where the item for sale is yet to come into existence at the time of the contract. 3) Ijarah (Lease) which is considered a sale of the usufruct of an asset. In addition to the absence of compound interest in ijarah, the leasing agency must own the leased object for the duration of the lease.

Financing contracts, on the other hand, include: 1) Murabahah (cost - plus sales) where the financier purchases a product on behalf of an entrepreneur who does not have enough capital to buy this particular product. The financier then sells the product to the entrepreneur with a profit margin added to the cost of the product. The payment is delayed for a specified period of time. 2) Tawarruq or "reverse Mudarabah," where a person buys a commodity from the seller on credit. Once the commodity is purchased, it is then immediately sold to a third party in the market at a spot price lower than the purchase price. The price will be paid, either in instalments or in full but in the future.

Intermediation contracts consist for example both Musharakah and Mudarabah contracts. 1) Musharakah (partnership) where two or more parties combine either their capital or labour to share the profits and losses. Every partner is considered an agent of and for the other. Under Musharakah contracts, the profit is shared in any pre-agreed proportion while both party shares the proposed loss in a strict proportion to the contributed capital. Islamic banks can use also what so-called diminishing Musharakah (Musharakah Mutanaqisah), where the bank keeps on reducing its ownership (equity share) in an asset against clients' periodical rental payments until the client becomes the sole owner for the asset. 2) Mudarabah is another participatory mode whereby one party of the contract provides the capital while the other party put efforts and skills to manage the project. Both parties share generated profits according to a pre-agreed ratio. Losses however are borne only by the provider of the capital.

Given the above-discussed differential characteristics of Islamic banking, there has been a question about the long-term ability of Islamic banks to emerge as an effective source for financing development in the international

financial markets. Efficiency performance is an important tool to show the levels of improvement in banks' managerial performance to wisely utilize inputs to generate profit and/or to control costs. Accordingly, the efficiency performance of Islamic finance performance considered an important issue that needs more examination.

1.2 Significance of the Study and Contribution to Knowledge

Islamic banking and finance are experiencing a rapid growth worldwide with a growth rate of 10-12 percent over the past decade [11]. The growth in Islamic finance is driven by the increasing oil wealth in the gulf region and the growth of world's Muslim population [12]. The estimates revealed that by 2050 Islam will become the world's dominant religion [13]. This will increase the overall global demand for Islamic financial products and services. Islamic banking assets grew at 17.6 percent per annum over the period from 2009 to 2013 and will grow by an average of 19.7 percent a year up to 2018 [14]. Industry analysts further expected that the global value of the Islamic financial assets is expected to reach US\$2,825 trillion in 2021 [2].

Regionally, the Gulf Cooperation Council (GCC) accounts for more than 39.5 percent of the global Islamic financial assets. The share of both Middle East countries and North Africa has reached to 33.2 percent. Malaysia, Indonesia, Pakistan and Bangladesh contributes to the total Islamic financial assets with about 21.9 percent. Islamic banking is the biggest contributor to the Islamic finance value, with about 76% of total Islamic finance assets [2].

Despite the notable growth in Islamic finance and banking, this sector is still in the very early stages of development in Europe although it has gradually gained importance in some European countries such as the United Kingdom and Luxembourg. The regional Islamic banking assets accounted in 2014 for only 0.5 percent of the global Islamic total [15]. The number of institutions located in the UK that offer Islamic finance services is far ahead of other Western countries. Assets of UK financial institutions offering Islamic finance services surpassed \$5billion in 2016 [16]. UK was the first European country to issue a sovereign Sukuk in 2014 with a total amount of £200 million maturing in 2019. To date, 57 Sukuk issues have been listed in London Stock Exchange with a total value of \$51billion. Recently, Luxembourg,

Switzerland, Germany, and Ireland are also considered major centers operating with Islamic funds.

Given the above discussion and taking into consideration the fact that Islamic banking sector continues to be the dominant segment that accounts for more than 80 percent of the global Islamic financial institutions Thomson [2], there should be a significant number of papers to address the important issues related to Islamic banking performance. Nevertheless, research papers are still rare. Therefore, the significance of this study tends to start from the unavailability or the little research works have examined the efficiency performance of Islamic banks in a comparative context (Islamic banks versus conventional banks). The purpose of this study is to fill this research gap to provide knowledge to foreign investors who are considering investing in Muslim majority countries. Results are also beneficial for Muslim investors who wants to introduce Islamic banking into a full conventional system outside its current boundaries.

Additionally, the results arise from measuring the efficiency performance of Islamic versus conventional banks might offer significant implications for Muslim and no Muslim portfolio managers who want to reflect their religious and ethical values in their investments. This is because results give some indications for potential diversification opportunities arising from Islamic banking investments, which become more significant during global financial crisis. Some researchers argue that Islamic investments have less risk exposure and thus might be an option for risk averse investors even if reward them with lower returns as compared to conventional investments [17]. On the contrary, some other researchers argued that the Islamic investments bear higher risk as compared to conventional investments thus generate high returns which attract risk seeking investors [18].

Due to many economic and financial reforms, Muslim countries from the gulf cooperation council have become fast growing economies worldwide. Recently, the changes in policies in Muslim countries due to the unstable political and economic situations have changed the financial market as well as the banking sector. Changes in oil prices could negatively affect the inflow of money and thus the economic growth in the Gulf Cooperation Council. Lower economic growth means lower liquidity and lower growth opportunities for Islamic banks [12]. The role of

Islamic finance in economy shapes future policy-oriented researches. Information about the banks performance is vital to examine banks possible impact on countries economic growth rates which in turn affects the priority that policymakers attach to reforming financial sector strategies. Accordingly, it is important to study banks efficiency performance in the periods of pre, during and post global financial crisis of 2008 in order to help governments and policymakers to reform financial policies and regulatory issues in order to facilitate Islamic financial transactions in their financial system.

The concept of Islamic banking was discussed rarely and extremely from a religion point of view (e.g, [19,20,21]). Moreover, limitations of existing empirical studies are; they commonly used the financial ratios as a proxy of performance, which expressed the performance and achievement in monetary terms; they primarily considered in Muslim majority countries. It is therefore uncertain as to whether the existing studies' findings about the banks performance are also applicable when applying nonparametric measures to examine banks "efficiency" performance.

Moreover, the global economic meltdown of 2008 has triggered financial failures of many international conventional banks. Islamic banks appeared to be immune to the global financial crisis [22,23]. By contrast, Kassim [24] showed that both Islamic and conventional banks had been largely affected by the global crisis. The mixed results of existing studies thus remain inconclusive and need further investigation.

This study contributes to the literature by answering the following questions; 1) Are there any differences in the effective performance of Islamic versus conventional banks? 2) Can Islamic banks be the optimal substitute for conventional banks in the international financial markets outside Muslim majority countries? 6) Are Islamic banks really immune to the financial crisis?

The results arise from this study could offer valuable implications for investors and portfolio managers who want to reflect a positive attitude toward religious values in their market investments. Moreover, information about Islamic banks performance can be used to determine the priority that advisors attach to reforming financial sector policies for further growth in the economy.

The remainder of this paper is organized as follows. Section 2 provides a literature review with reference to the efficiency performance of Islamic and conventional banks. The data and the underlying methodology are given in Section 3, while Section 4 reports and discusses the empirical findings. Section 5 then concludes the paper.

2. LITERATURE REVIEW

While there is a large number of existing literature investigating the performance of conventional banking systems over recent years, the empirical evidence examining the efficiency performance of Islamic banks and its relationship with countries economy is still at its infancy.

Empirical researches on the efficiency performance for Islamic banks are still few in Muslim majority countries and very rare in Europe. This is because of the lack of sufficient and accurate data and the short global presence of Islamic banks. However, the literature on Islamic finance has obviously grown recently with the bulk of the academic work discussed theoretically the regulatory and supervisory challenges related to Islamic banking (e.g. [25]). There were also some empirical attempts to analysis the performance of Islamic finance using the most widely used financial ratios such as; [26,27,28,29,30,31,32].

Modern studies have sought to estimate Islamic bank performance outside their traditional borders using various frontier functions and econometric techniques. Limam [33] used a stochastic frontier model (SFA) to examine the pure technical efficiency (i.e., how optimally the bank uses physical capital, financial and labour resources to generate earning) of banks in Kuwait from 1994 to 1999. For the analysis, Limam considered one output: earning assets; and three inputs: fixed assets; number of bank employees; and deposits and borrowings. Limam [33] reported that banks' efficiency is associated with larger size, higher equity capital and greater profitability.

Utilizing the stochastic cost frontier approach, Hussein [34] examined the cost efficiency of 17 Islamic banks' operating in Sudan between 1990 and 2000. He used three input prices includes the unit cost of capital, funds, and of labour, and three outputs, which are; investment in Murabaha, Investment leasing, Musharaka, and Istisna'a. The results showed that the state

owned banks were most cost inefficient than smaller banks with the foreign-owned banks were the most efficient.

Maji et al. [35] measured the cost efficiency of thirty-four conventional and Islamic banks in Malaysia over the sample period of 1993-2000. Findings revealed that the efficiency of both groups of banks was to some extent similar. In addition, Maji et al. [35] found no particular evidence to claim that the ownership type, i.e. private or public, affects bank efficiency.

Yudistira [36] estimated the efficiency and stability of Islamic banks. This study used the Data Envelopment analysis (DEA) approach to measure technical and size efficiency of banks. The results showed the Islamic banks negatively affected by the global crisis over the period from 1998 to 1999. Finding also showed that Islamic banks suffer from diseconomies of scale and thus suggest mergers should be encouraged. However, this study did not compare the performance of Islamic banks with conventional banks. Therefore, the results are not accurate enough to ensure that Islamic banks are highly adversely affected by the global crisis. This is because Islamic banks could have been affected by the crisis but still better than conventional counterparts' banks.

Hassan [37] used the SFA and the DEA techniques to evaluate the comparative cost, profit, X-efficiency, and productivity of forty-three Islamic banks in twenty-one countries over the period from 1993 to 2001. Findings specified that the traditional banks were technically more efficient than Islamic banks but the later was found to be more profit-efficient.

Mokhtar et al. [38] investigated the cost and technical efficiency of Islamic and mainstream banks in Malaysia for the period from 1997 to 2003. The study used the SFA. Overall, results show that the industry of Islamic banking had shown a lower level of efficiency but higher increasing trend in its overall efficiency performance than mainstream banks. Results further showed that full Islamic banks are financially better than Islamic window.

Sufian [39] used DEA approach to examine banks' performance in Malaysia over the sample years 2001 to 2005. According to [39], the Malaysian Islamic banks' efficiency performance declined in year 2002 but recovered slightly in the following two years (2003 and 2004). Findings also showed that the domestic Islamic

banks were more efficient than the foreign Islamic banks. The source of inefficiency of Malaysian banks had been largely scale in nature.

Johnes [40] investigated the performance for Islamic versus conventional banks in the Gulf Cooperation Council during 2004-2007. Based on the financial ratios, results showed that Islamic banks tend to be less cost efficient but more revenue and profit efficient than mainstream banks. While utilizing the DEA technique revealed that conventional banks were more technically efficient than Islamic banks.

Kamaruddin et al. [41] applied the DEA technique to analysis the performance of Islamic banking operations in Malaysia during the period from 1998 to 2004. They investigated both cost and profit efficiency (the minimum cost and the maximum profit each bank could attain, respectively) of full-fledged Islamic banks and Islamic windows. Authors found that Islamic banks were relatively more efficient in controlling costs, which comes mostly from inefficient management of resource and economies of scale.

Bader et al. [42] estimated the efficiency of 37 conventional banks and 43 Islamic banks in 21 countries between 1990 and 2005. They principally used the DEA approach. Findings suggested that there were no significant differences between the overall efficiency results of Islamic versus conventional banks. Overall, banks were found inefficient, to some extent. Most inefficiencies came from the revenue side. Yet, there was substantial room for more cost, revenue, and profit efficiency. This was particularly because of a slack that appeared in the usage of resources across all banks.

Mokhtar et al. [43] examined the competitiveness of shari'ah compliant banks versus mainstream banks in Malaysia. This study used the DEA approach to investigate the cost and technical efficiency. Findings showed that the efficiency of Islamic banks increased during 1997-2003. It also revealed that the Islamic banks were more efficient than conventional banks with Islamic windows but pure conventional banks were surprisingly found to be more efficient than full Islamic banks and other conventional banks with Islamic windows.

Abd-Majid and Kassim [44] estimated the efficiency of conventional and Islamic banks in

10 countries using the SFA. The study covered the period from 1996 to 2002. Their analysis took into consideration the accessibility of bank services, type of bank and the environmental influences. Islamic banking performance appeared to be associated with higher input usage. Results also revealed that Islamic banks were found to have higher returns to scale as compared to conventional banks. However, overall findings suggested that the key challenge for Islamic banking is to identifying and overcoming the factors that cause Islamic banks to have relatively low potential outputs for given input usage levels. Findings suggested, for example, that Bahrain and Bangladesh had higher estimated efficiency than Sudan and Yemen. Most sample banks (Islamic and conventional) exhibited a bit low returns to scale. Yet, Islamic banks were found to have relatively higher returns to scale than conventional banks.

Kablan and Yousfi [45] estimated the efficiency of Islamic banks from 17 countries. The study covered the period from 2001 to 2008. They used the method of stochastic frontier in a first step and then secondly they estimate a Tobit model with the efficiency scores derived from first step and explanatory variables for efficiency that they found consistent to Islamic banks. Findings showed that around 80 percent of Islamic banks were efficient. Asian countries had the highest efficiency. Results also found that Islamic banks were not sharply affected by the subprime crisis of 2008. This indicated that they were relatively immune. Furthermore, results showed that banks' profitability and the market power had adversely affected by their efficiency performance. Eventually, banks concentration led to higher costs through slacks and inefficiency.

Qureshi and Shaikh [46] applied the DEA in order to examine the banks' technical efficiency performance in the Pakistan's banking system. Qureshi and Shaikh also utilized the most used ratio analysis technique to analysis profit, revenue, and cost comparative efficiency of the sample throughout the period from 2003 to 2008. The selected tested sample banks consist of Islamic banks, conventional banks, and conventional banks with Islamic banking division. The results revealed that the difference in the scores of Islamic and conventional banks is insignificant. The scale efficiency was considered a major component for overall efficiency. A negative relationship was observed between bank size and efficiency of all banks types thus

mergers, acquisitions and (or) increased capital base may be not the best ways to increase banks' efficiency. Findings showed also that conventional banks were more revenue efficient and less cost efficient. Findings suggested that Islamic banks should increase their size in order to benefit from their scale of operation (economics of scale).

Ajlouni and Omari [47] utilized both the Malmquist (MPI-DEA) and financial ratio analysis to estimate the efficiency performance of Jordanian Islamic banks over the period from 2005 to 2009. They found the Islamic banks in Jordan are always efficient in terms of their inputs producing actual outputs. Furthermore, there was no observe evidence on the relationship between FRA and DEA bank rankings. In order for managers to increase banks' efficiency by producing optimal outputs findings suggested that managers of Jordanian Islamic banks should improve recourse utilization.

Abdul and Rosman [48] estimated the efficiency of 63 Islamic banks along the period from 2006 to 2009 in Middle East and North Africa (MENA) region and Asian countries. They used (DEA) approach. Islamic banks' technical inefficiency is found to be mostly due to their non-optimal size of operation (scale). Islamic banks, in general, achieved high rates of technical efficiency, indicating that the ability of the banks' management to control costs in an efficient way. On average, results showed that Islamic banks from Asian countries outperformed Islamic banks from MENA (including Gulf Cooperation Countries) countries in terms of overall efficiency performance.

Saeed et al. [49] analyzed the efficiency of 19 conventional and Islamic banks in Pakistan between 2007 and 2011. They used both two approaches; non-parametric Data Envelopment Analysis technique and the ratio analysis technique to calculate technical banks' efficiency. Lending funds, deposits and portfolio investments were taken as output vectors while input vectors where chosen to be borrowed funds and capital. Results showed that the performance of Islamic banks is worse than conventional. Conventional banks were also found to be better in term of efficiency and liquidity ratio.

Said et al. [50] examined the cost efficiency of Islamic versus conventional banks in Malaysia for the period from 2006 to 2009. They used both

the DEA approach and Tobit regression analysis to determine influence factors. They found the conventional banks were efficient in information technology. Islamic banks were found to be technically efficient mainly due scale (size) of operation. Results showed that capitalization and bank sizes were significantly positively associated with efficiency while loan quality was found to be significantly negatively associated to efficiency. Allocative efficiency was found to be the main contributor to Islamic banks cost efficiency.

Zuhroh et al. [51] utilized the SFA approach to estimate the cost efficiency performance of a sample banks from Indonesia. It also extends the analysis to determining sources of cost inefficiency and managerial competency of three publicly traded Islamic banks and nineteen mainstream banks. The analysis covered the period from 2004 to 2010. The results showed that Islamic banks were superior in their technical efficiency performance, but the banks' cost efficiency was much lower than mainstream banks.

Yilmaz et al. [52] used the DEA approach in order to measure the comparative technical performance of 4 Islamic banks and 28 conventional banks in Turkey over the period from 2007 to 2013. The results indicated that during all years of study, Islamic banks were found to be more technically efficient than conventional banks. As compared to conventional banks, scale inefficiency (inappropriate scale of banking operations) dominated the pure technical inefficiency in determining the overall technical efficiency of Islamic banks. The rest of banks overall technical inefficiency appeared to be mainly due to the poor management practices and selecting incorrect input combinations.

Bukhari and Harrathi [53] employed the DEA to examine the efficiency performance for both Islamic and conventional banks. The analysis covers the period from 2006 to 2012. The sample consists of 28 conventional banks and 20 Islamic banks from 6 countries in the GCC. Results showed that the efficiency performance of both Islamic and conventional banks efficiency is the same in Saudi Arabia, Kuwait and Qatar. While conventional banks are found to be more efficient than Islamic banks in Bahrain and Emirates.

Most recently, Romdhane and Alhakimi [54] used the Malmquist index (MPI) to analyze the

efficiency performance of 36 Islamic banks in 15 countries over the period from 2003 to 2011. Findings showed that banks from the Gulf region were found the most efficient. Moreover, Islamic banks technical efficiency was the main driver of improving banks' productivity.

Albeit our study is an enhancement of some of existing works, it differs in the following aspects: The sample time period is current and longer, and we develop a more comprehensive country sample.

3. DATA AND EMPIRICAL METHODOLOGY

3.1 Data

This study is considered exclusive in considering a large number of banks from Muslim majority countries and Europe. However, there remains no consensus on the number of key players of world Islamic banks. Consequently, when no census data are available, it is difficult to determine the actual size of the (population) research. Accordingly, and as the number of Islamic banks worldwide is still relatively few, in this research, the analysis covers all "fully fledged" Islamic commercial banks with complete data for the whole period of analysis. The study is based mainly on panel data for 44 Islamic banks and 44 conventional banks from 20 countries namely; UAE, Qatar, Bahrain, K.S.A, Egypt, Malaysia, Thailand, Turkey, Singapore, Jordan, Palestine, Bangladesh, Pakistan, Sudan, Yemen, Syria, Gambia, Iran, U.K, and Bosnia) to analyze the efficiency performance of Islamic versus conventional banks.

As the researcher is aware to include in this study the maximum number of banks for the validity of proposed tests, data are collected from the Orbis Bank Focus (formerly Bankscope) database. In those cases, where the necessary banking data were not available on Orbis Bank Focus, the researcher refers directly to banks' annual reports and financial statements. Furthermore, in order to collect the percentage changes in the countries' GDP per capita the researcher uses the World Bank Database.

3.2 Empirical Methodology

The primary goal of this study is to measure the efficiency performance of Islamic versus conventional banks. Performance analysis is very important for the evaluation of banks'. To

estimate banks' performance, researchers can apply different methods. Analysis of banks financial statements (ratio analysis) is the most common and popular performance analysis method in banks. Ratio analysis is a quantitative method that is used to determine the financial status of a bank. Financial ratios have some limitations. The number of financial indicators is big and the therefore make interpretation of results more difficult. Unlike existing studies, the researcher prefers measuring financial performance of banks using common financial ratios as only a first step and in a second step; the researcher properly utilizes the non-parametric approach of DEA to examine the banks efficiency performance because ratio performance measures are limited in considering different financial aspects of banks.

3.2.1 DEA analysis

Researchers commonly claim that efficiency has a direct connection with the utilization of scarce resources thus is best described as the minimum level of resources that are needed to run a business in a given financial system compared to how much resources that are used in the actual operations. A bank efficiency could be best described as the performance of a bank given its minimum resources (inputs) and the highest possible results (outputs) relative to other banks [55].

There is no consensus in the literature as which of the two approaches of the DEA and SFA is better as each one of the two approaches has its own pros and cons. Iqbal and Molyneux [56] argued that the parametric measures need assumptions about the form of cost and/or profit function. On the other hand, the non-parametric approaches do not require such specification of the functional form.

However, DEA is the best non-parametric approach to estimate efficiency performance of banks [57]. DEA shows how a particular bank technically operates in a relative base to other best practice banks operating in the same tested sample. Based on DEA estimates a bank is considered efficient if no other bank produces the same amount or more outputs given a certain level of inputs, or uses less inputs given the output level of production.

DEA does not need a large number of observations thus works properly with small bank samples. DEA helps to determine the causes of

inefficiency, which are not apparent from financial analysis [58]. DEA provides stability of measured efficiency over time (Huang and Wang, 2002). Consequently, the researcher adopts the DEA approach in order to measure the efficiency performance of Islamic versus conventional banks over the period from 2005 to 2016.

3.2.2 The empirical models for DEA approach

Empirical researches use quantitative empirical evidence. Empirical researches starts from specific observations to create a particular model based on given theoretical models. The theoretical model of DEA approach estimates banks technical efficiency under both the Constant>Returns-to-Scale (CRS) and the Variable>Returns-to-Scale (VRS). The CRS describes the process of production where the output of the process increases or decreases simultaneously and by the same proportion as inputs are changed. While VRS holds when an increase in inputs does not cause a change in the outputs. The CRS is used commonly when Decision Making Units (DMUs) are optimal in their scale level of operations. Factors like for example imperfect competition and constraints on finance are likely to make banks not to be able to operate in an optimal level. Accordingly, this study compares Islamic banks to benchmarks mainstream banks using DEA approach under the assumption of VRS [58].

Furthermore, DEA examines the banks efficiency based on either an output- oriented model (i.e. output/input) or an input-oriented model (i.e. input/output). The first model measures technical inefficiency as a relative increase in the output vector while the second model aims to identify technical inefficiency as a relative decrease in input usage. However, there is no consensus in the literature as which is better to use of the two orientation models. This study assumes an output-oriented approach. This is because it fits better with the nature of the study sample from Islamic banks. Islamic banks are trying to offer better and unique products thus work toward increasing their competitive privileges by increasing level of outputs [36].

In the DEA model, it is important to have a suitable number of DMUs to avoid overestimation of efficiency scores [59]. Our sample is large enough to overcome such problem. The researcher manages to analysis all banks with complete information and valuable input and output vectors. Moreover, the researcher follows

the proposed technique suggested by Cooper et al. [58] and Darrat et al. [60] to have an appropriate number of outputs and inputs thus, the product of our inputs time's outputs is less than the overall sample size.

Eventually, to apply DEA the banks in our sample must perform the same tasks with a similar objective. Islamic and mainstream banks in our sample have the same final target goal of earning profit regardless of as how to achieve this goal.

In DEA model, the researcher can use either the intermediation or the production approach. The first approach considered banks as financial intermediary while, the second approach views banks as producers of loan using deposits, labor or staff expenses, and cost of intermediation process or other operating expenses. This study utilizes the DEA intermediation approach because the core principle of Islamic banks is the profit and loss sharing [36].

Following most of the literature, our analysis consists of 3-inputs and 2-outputs. The researcher uses "x1= total deposits and short term funding", "x2= personal or administrative

expenses", and "x3= other operating expenses" as inputs. While the researcher uses both "y1=total loans" and "y2=net income" as outputs. As it is prohibited in Islamic finance to deal with interest, the researcher uses income distributed to the depositors instead of interest rates used in conventional banks [61,62].

The inputs-outputs correlations have a significant impact on the robustness of the results. A low correlation of an input (output) variable with all outputs (inputs) may indicate that this variable does not fit the model [64]. Consequently, the Pearson's coefficient of correlation is employed to examine if the selected inputs/outputs meet the correlation assumption.

To illustrate the applications of DEA, suppose for example that we have n DMUs. Each DMU transforms (n) inputs to (m) outputs. The efficient DMUs will have the highest ratio of the weighted sum of outputs to inputs. Efficiency performance (E_s) is calculated as follows [65]:

$$E_s = \sum_{i=1}^m u_i y_{is} / \sum_{j=1}^n v_j x_{js}, \text{ for } i = 1, \dots, m \text{ and } j = 1, \dots, n, \tag{1}$$

Where y_{is} is the quantity of the i_{th} output produced whereas x_{js} is the quantity of the j_{th} input. u_j is the output weight while v_j is the input weight. E_s is maximized to guarantee non-negative weights as follows:

$$\sum_{i=1}^m u_i y_{ir} / \sum_{j=1}^n v_j x_{jr} \leq 1, \text{ for } r = 1, \dots, N \text{ and } u_i \text{ and } v_j \geq 0, \tag{2}$$

Following Charnes et al. [63], the fractional linear program can be transformed into the following ordinary linear program:

$$\begin{aligned} \text{minimize } e_s &= \sum_{i=1}^m u_i y_{is} \\ \text{subject to } &\sum_{i=1}^m u_i y_{is} - \sum_{j=1}^n v_j x_{jr} \leq 0, r = 1, \dots, N; \\ &\sum_{i=1}^m v_j x_{js} = 1 \text{ and } u_i \text{ and } v_j \geq 0 \end{aligned} \tag{3}$$

Furthermore, the above formula can be transformed into the following dual problem:

$$\begin{aligned} \text{minimize } &\xi_s \\ \text{subject to } &\sum_{r=1}^N \varphi_r y_{ir} \geq y_{is}, i = 1, \dots, m; \\ &\xi_s x_{js} - \sum_{r=1}^N \varphi_r y_{ir} \geq 0, j = 1, \dots, n; \varphi_r \geq 0, \text{ and } 0 \leq \xi_s \leq 1. \end{aligned} \tag{4}$$

Where (ξ_s) is the total technical efficiency (TE) scores of the s_{th} DMUs.

A DMU is considered to be efficient if it has a score of 100 percent. If a DMU is found to be efficient with some slacks (overuse of inputs or under production of outputs), then we can conclude that there exists a combination of other units that may be termed as weakly efficient. The researcher applies the multi-stage DEA to solve for possible slacks as suggested by Coelli [65].

3.2.3 Two-sample t-test for equal means

In this research, the researcher measures banks efficiency performance over the entire period of 2005-2016. The researcher also separately calculated efficiency scores for each sub period; pre-crisis (2005-2007), during crisis (2008-2010), and only three years post crisis from 2011 to 2013 to avoid having biased results due to the longer post crisis period. However, results regarding differences in the performance of banks obtained from analyzing separate periods are arbitrary. Accordingly, to measure the significance of the differences of banks performance pre, during, and post financial crisis of 2008, the two-sample T-Test for equal means is used to determine if the two population means are equal. The null hypothesis of $H_0: \mu_1 = \mu_2$ states that the variances for the two samples are equal. If $p \leq .05$, then difference is significant, null is incorrect and thus "reject the null".

4. EMPIRICAL FINDINGS

4.1 Descriptive Statistics for the Input-Output Variables

Table 1 below shows a summary of the most frequent descriptive statistics for the inputs and outputs used in this study to calculate both the efficiency performance of Islamic and conventional banks. Table 1 represents the descriptive statistics of the model. In the table, banks' deposits, banks' total expenses, and banks' personal expenses are the inputs in the efficiency models. While banks' total loans and banks' total revenues are the model's output factors. The sample total number of observation is 5,288 (=12 years*88 banks* 5 variables) from the period of 2005 to 2016. In this stage of analysis, the researcher examines the efficiency performance of the sample banks using DEA approach. DEA measures the efficiency by

comparing observed performance with best practice reference units [66].

In this stage of the analysis, the researcher runs the DEA analysis in favour of SFA. DEA has the advantage that it does not impose any assumptions on the functional form relating inputs to outputs, as it is direct data-driven approach [67]. Linear programming- based nonparametric tests are referred to as distribution-free tests mainly due to the fact that they do not assume that the data is normally distributed [68]. DEA does not attempt to find the "best-fit" of the data like regression. DEA only determines those banks that have maximized the use of inputs to create an "efficiency frontier" [69].

The availability of data may affect the choice of inputs and outputs in practice. However, an important issue in applying DEA is the degree of correlation between the inputs and the outputs, which could affect the robustness of the DEA model [70]. According to Boussofiene et al. [71], if a pair of inputs is highly positively correlated then one may be omitted. The same applies to outputs. Ueda and Hoshiai [72] and Lønborg [73] indicated also that variables used as inputs and outputs in DEA are usually correlated to some extent. Francisco et al. [74] revealed that a high correlation between inputs and outputs leads to a positive bias on efficiency scores on the average. Results of correlation analysis for each pair of variables are presented below in Table 2. Results show that the correlation coefficients are low between the three inputs. Correlation is also weak between the two outputs. Moreover, the correlation coefficients between inputs and outputs is not so high. Accordingly, the matrix meets the correlation assumption of DEA.

4.2 Banks Efficiency Scores over the Period from 2005 to 2016

This section discusses the results obtained from applying the nonparametric technique of DEA with respect to the efficiency performance of Islamic banks and their counterparts' conventional banks. It also considers the results obtained from the given analysis to test the first and second hypotheses in this study, which stated that: H_1 : *Islamic banks have better efficiency performance than conventional banks.* H_2 : *Islamic banks efficiency performance in pre-, during- and the post-crisis period was better than conventional banks.*

4.2.1 Efficiency performance of Islamic versus conventional banks: DEA approach

Table 3 illustrates the efficiency performance scores of Islamic banks relative to counterparts' conventional banks from both Muslim majority countries and Europe. Under the assumption of variable return to scale (VRS), the findings indicate that the average VRS scores for all Islamic banks over the sample period from 2005 to 2016 is approximately 96.7% which is relatively higher than the average scores of 95.1% recorded by the counterparts' conventional banks over the same sample period. VRS represents the "pure technical efficiency or PTE", which captures the effect of management practices on performance and measures efficiency after eliminating the effect of scale (size) of operations. PTE measures how far a bank is from the production frontier under conditions of variable return to scale (VRS). As 96.7% for Islamic banks > 95.1% for conventional banks thus, it seems that Islamic banks management is relatively better and more efficient than conventional banks in mixing the best combination of banks' inputs and outputs to achieve the highest possible efficiency scores. Efficiency scores recorded by Islamic banks ranged from 87.1% to 1. While the range for the efficiency scores recorded by conventional banks is between 85.2% and 1 indicating that, the lowest efficiency score was recorded by conventional banks. On average, Islamic banks outperform conventional banks in Qatar, K.S.A., Jordan, Palestine, Egypt, Sudan, and surprisingly in U.K. This indicates that those banks carried out operations very close to the efficient production frontier. Moreover, it appears from Fig.1 and Fig. 2 below that the majority of Islamic and conventional banks operate relatively below the efficient frontier. 18 conventional banks showed a superior efficiency performance of '1' over Islamic banks yet, the later have lower scores volatility and are much closer "on average" to the efficient frontier of DEA as compared to the counterparts' banks. These results imply that on average Islamic and conventional banks have a proper room for improvement by producing the same output levels by either using fewer resources than they employed in respective years or by controlling and reducing costs to sustain a competitive substantial advantage in the financial markets [42].

DEA measures also bank' efficiency scores under the constant returns to scale CRS. CRS

assumes that the output will change by the same proportion as inputs are changed. Scale efficiency measures the relative production loss (or cost increase) caused by a deviation from a CRS frontier. Thus, scale inefficiency may be associated with either increasing returns to scale (economies of scale-irs) or decreasing returns to scale (diseconomies of scale-drs). A bank is considered to be operating under drs if changing all inputs by the same proportion results in a smaller proportional change in outputs. While irs occurs when the output increases by a larger proportion than the increase in inputs during the production process [65]. The CRS assumes that there is no relationship between the scale of operations and banks performance thus small banks can be efficient as large banks. CRS measures banks "technical efficiency", which takes into account the input/output configuration and the size of operations. Findings suggests that Islamic and conventional banks alike operate relatively below the optimal size of operation (CRS <1). Accordingly, both types of banks are on average not fully efficient (100%) which is driven also by the inappropriate scale (size) of operations over the sample period. Moreover, Islamic and conventional in the sample exhibited a decreasing return to scale (RTS=drs), therefore, operate at a large scale. Both types of banks can improve efficiency by shrinking down banking activities and services simply because expanding existing services is not likely to increase banks performance unless quality can be ensured.

Overall results suggest that Islamic and conventional banks are on average not fully efficient. The overall PTE has been observed to be higher than TE (VRS> CRS) indicating that technical inefficiency of banks is largely due to the scale inefficiency 'diseconomies of scale'. While small portion of inefficiency is due to "poor resource management practices" (managerial capability). Moreover, it is known that Islamic banks are younger and smaller in size compared to the conventional banks. Yet, Islamic banks are found to be on average highly efficient as conventional banks over the sample period. This suggests that it is not always true to assume that the "older and bigger banks are always better" (see Fig. 3). Findings are consistent with Abdul et al. [75], Bader et al. [42].

Results thus far indicate that Islamic banks can be on average as efficient as conventional banks. Therefore, possess the ability to successfully compete with conventional banks.

This result supports the findings of Afiatun and Wiryono [76]. Islamic banks in some Muslim countries outperform conventional banks while some Islamic banks from Europe ranked ahead of some Islamic banks from Muslim majority countries. Accordingly, albeit they are technically inefficient and there is no sufficient evidence against their average super performance, Islamic

banks were found better than conventional banks, therefore, findings suggest to accept the first and second hypothesis regarding the comparative performance of Islamic and conventional banks. However, the results are still inclusive and need further analysis to examine the significance of the results by applying t-test.

Table 1. Descriptive statistics for input and outputs variables, 2005-2016 (mill USD-\$)*

	Min.	Max.	Mean	Std. dev.
Customers deposits	01,380	114,39	09,217	15,401
Personal expenses	0,3540	09,128	02,366	12,739
Other operating expenses	01,115	09,731	06,499	05,791
Total loans	01,707	707,93	11,538	40,986
Net income	0,2430	07,630	4,857	05,999

**the selection of the inputs and outputs was primarily based on the literature. As it is always advised that inputs and outputs should be selected by expertise rather than using principle component analysis because the later suffers some drawbacks [72].*

Table 2. Correlation coefficients between input and output factors, 2005-2016

	Deposits	Personal expenses	Other O. expenses	Total loans	Net income
Deposits	1				
Personal expenses.	0,0314	1			
Other Operating expenses	0.0845	0.2993	1		
Total loans	0.3772	0.0090	0.0343	1	
Net income	0,0011	0,0693	0,1555	0,0034	1

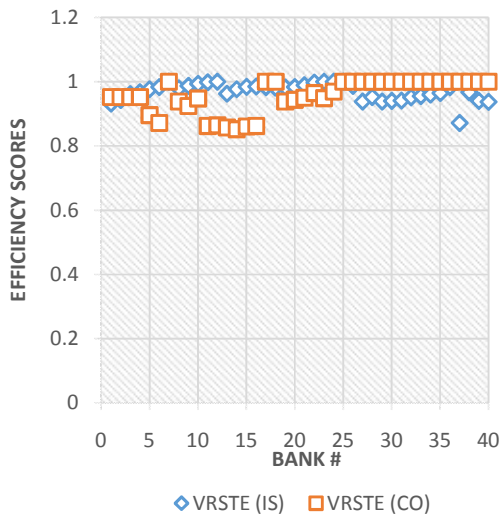


Fig. 1. Comparison between Islamic and conventional banks performance in terms of VRS

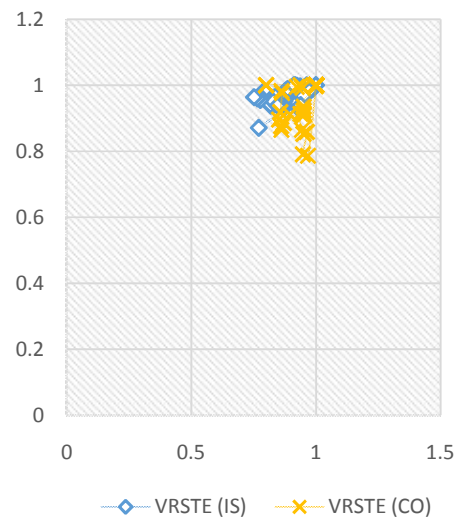


Fig. 2. Islamic banks and conventional banks efficiency scores distance from 1

Table 3. Average banks efficiency scores for the period from 2005 to 2016

Country	IS #	Bank name	CRS*	VRS	SCALE	RTS	CO.#	Bank name	CRS	VRS	SCALE	RTS
UAE	1	Abu Dhabi Islamic Bank	0.929	0.931	0.997	drs	1	National Bank of Umm Al Qaiwain	0.891	0.952	0.935	drs
	2	Dubai Islamic Bank plc	0.917	0.943	0.973	drs	2	United Arab Bank	0.879	0.952	0.923	drs
	3	Emirates Islamic Bank	0.948	0.961	0.986	drs	3	Mashreqbank	0.870	0.952	0.914	drs
	4	Sharjah Islamic Bank	0.841	0.967	0.870	drs	4	Bank of Sharjah	0.865	0.952	0.909	drs
Qatar	5	Qatar International Islamic	0.889	0.976	0.911	drs	5	Al Ahli Bank of Qatar	0.817	0.896	0.911	drs
	6	Qatar Islamic Bank SAQ	0.792	0.983	0.806	drs	6	Qatar National Bank	0.771	0.871	0.886	drs
Bahrain	7	ABC Islamic Bank (E.C.)	1.000	1.000	1.000	-	7	Ahli United Bank B.S.C.	1.000	1.000	1.000	-
	8	Bahrain Islamic Bank	0.932	0.979	0.952	drs	8	Arab banking corporation BSC	0.938	0.938	1.000	-
K.S.A	9	Bank Albilad	0.883	0.987	0.894	drs	9	Arab National Bank	0.919	0.924	0.995	drs
	10	Al Rajhi Bank	0.920	0.993	0.927	drs	10	Banque Saudi Fransi	0.940	0.947	0.993	drs
	11	Aljazira Bank	0.925	0.998	0.927	drs	11	Riyad Bank	0.848	0.862	0.983	drs
Jordan	12	Islamic International Arab B.	0.963	1.000	0.963	drs	12	Jordan Ahli Bank	0.843	0.864	0.976	drs
	13	Jordan Dubai Islamic Bank	0.781	0.962	0.811	drs	13	Cairo Amman Bank	0.788	0.857	0.919	drs
	14	Jordan Islamic Bank	0.964	0.976	0.988	drs	14	Jordan Kuwait Bank	0.763	0.852	0.896	drs
Palestine	15	Arab Islamic Bank	0.920	0.984	0.935	drs	15	Bank of Palestine	0.753	0.860	0.876	drs
Syria	16	Syria International Islamic	0.912	0.985	0.925	drs	16	Commercial Bank of Syria	0.746	0.862	0.865	drs
	17	Cham Islamic Bank	0.893	0.983	0.909	drs	17	Bank of Syria and Overseas	0.997	1.000	0.997	drs
Yemen	18	Islamic Bank of Yemen	0.886	0.981	0.903	drs	18	National Bank of Yemen	1.000	1.000	1.000	-
Egypt	19	Faisal Islamic Bank	0.876	0.982	0.892	drs	19	Commercial International Bank	0.856	0.938	0.913	drs
Sudan	20	Islamic Co-operative D. B	0.882	0.983	0.897	drs	20	Bank of Khartoum	0.816	0.944	0.865	drs
	21	Faisal Islamic Bank (Sudan)	0.887	0.989	0.897	drs	21	Al Jazeera Sudanese Jordanian B.	0.811	0.950	0.853	drs
	22	Sudanese Islamic Bank	0.937	0.997	0.940	drs	22	Sudanese Egyptian Bank	0.827	0.964	0.858	drs
	23	Al Shamal Islamic Bank	0.918	1.000	0.918	drs	23	Trade and Development Bank	0.750	0.948	0.791	drs
	24	Tadamon Islamic Bank	0.912	1.000	0.912	drs	24	Blue Nile Mahsreg Bank	0.762	0.969	0.786	drs
	25	Arab Gambian Islamic Bank	1.000	1.000	1.000	-	25	Skye Bank Plc	1.000	1.000	1.000	-
Pakistan	26	Burj Bank Limited	0.985	0.987	0.998	drs	26	National Bank of Pakistan	1.000	1.000	1.000	-
	27	Dubai Islamic Bank Pakistan	0.855	0.938	0.912	drs	27	Habib Bank Limited (HBL)	1.000	1.000	1.000	-
	28	Albaraka Islamic - Pakistan	0.875	0.952	0.919	drs	28	United Bank Limited (UBL)	1.000	1.000	1.000	-
Bangladesh	29	ICB Islamic Bank Limited	0.819	0.938	0.874	drs	29	BASIC Bank Limited	1.000	1.000	1.000	-
Malaysia	30	Affin Islamic Bank Berhad	0.828	0.940	0.881	drs	30	AmBank	1.000	1.000	1.000	-
	31	CIMB Islamic Bank Berhad	0.818	0.941	0.869	drs	31	RHB Bank Berhad	1.000	1.000	1.000	-
	32	RHB Islamic Bank Berhad	0.829	0.951	0.871	drs	32	OCBC Bank (Malaysia)	1.000	1.000	1.000	-
	33	EONCAP Islamic Bank	0.777	0.955	0.814	drs	33	Public Bank Berhad	1.000	1.000	1.000	-
	34	Bank Muamalat	0.766	0.960	0.797	drs	34	Hong Leong Bank	1.000	1.000	1.000	-

Country	IS #	Bank name	CRS*	VRS	SCALE	RTS	CO.#	Bank name	CRS	VRS	SCALE	RTS
	35	Hong Leong Islamic Berhad	0.752	0.964	0.780	drs	35	Maybank International	1.000	1.000	1.000	-
Thailand	36	Islamic Bank of Thailand	0.974	0.983	0.990	drs	36	Tisco Bank	1.000	1.000	1.000	-
Singapore	37	Islamic Bank of Asia (The)	0.771	0.871	0.886	drs	37	DBS Bank Limited	1.000	1.000	1.000	-
Turkey	38	Kuveyt Turk	0.950	0.967	0.983	drs	38	Akbank T.A.Ş	1.000	1.000	1.000	-
	39	Turkiye Finans	0.939	0.940	0.999	drs	39	Anadolubank A.Ş.	1.000	1.000	1.000	-
	40	Albaraka Turk Participation B.	0.879	0.937	0.937	drs	40	Türk Ekonomi Bankası A.Ş.	1.000	1.000	1.000	-
	41	Asya Katilim Bankasi	0.875	0.938	0.933	drs	41	Türkiye İş Bankası A.Ş.	0.800	0.800	1.000	-
U.K.	42	Al-Rayan Bank U.K.	0.865	0.937	0.923	drs	42	Barclays	0.800	0.800	1.000	-
Bosnia	43	Bosna Bank International	0.857	0.938	0.914	drs	43	Intesa Sanpaolo Banka	1.000	1.000	1.000	-
Iran	44	Bank Sepah	0.846	0.938	0.903	drs	44	Bank Tejarat	1.000	1.000	1.000	-
Average			0.886	0.967	0.917				0.910	0.951	0.956	

* SCALE = CRS / VRS.

In terms of the effect of the financial crisis on banks' performance, findings from table (4) below show that conventional banks outperformed Islamic banks in the period before the crisis in terms of the recorded efficiency scores. This result is consistent with [45] who revealed that conventional banks are more technically efficient than Islamic bank. The superiority of the conventional banks over Islamic banks has been confirmed also by Milhem and Istaiteyeh [77] and Tlemsani and Alsuwaidi [78]. Surprisingly, while conventional banks faced a reverse progress (regress or gradual reduction) on their efficiency performance during the financial crisis period from 2008 to 2010, Islamic banks appeared to have an upward trend during this period in their performance despite the inefficient overall performance appeared from the values less than unity. Islamic banks succeeded to maintain a good performance after the crisis and thus became, on average, ahead of conventional banks over the sample period from 2011 to 2013 and from 2013 to 2016. This result supports the findings of Alamer et al. [23] in that Islamic banks were less affected by the global financial crisis of 2008 and thus are less vulnerable to economic shocks as they are better capitalized.

However, the interpretations above are still arbitrary. To determine if differences between the two types of banks are significant, the researcher employs the t-test for mean differences. Since the study consists of two "independent" samples that have come from two completely different populations (Islamic and conventional), the researcher utilizes the two-sample (independent) t-test.

4.3 Test for Equality of Means

The test for equality of means provides a basis for examining the efficiency performance of the two types of banks namely; Islamic and conventional banks. The most suitable test was the t-test for equality of means for the efficiency performance based on two groups, which are the types of banks [79]. The type of banks is represented by the variable dummy type whereby 0 symbolizes Islamic banks and 1 represents Conventional banks. The results for the test for the entire period, from 2005 to 2016 are as shown in Table 5 below. The computations have been categorized into the number of observations, the means, standard errors, standard deviations, and the confidence interval at 95% significance level for each type of bank.

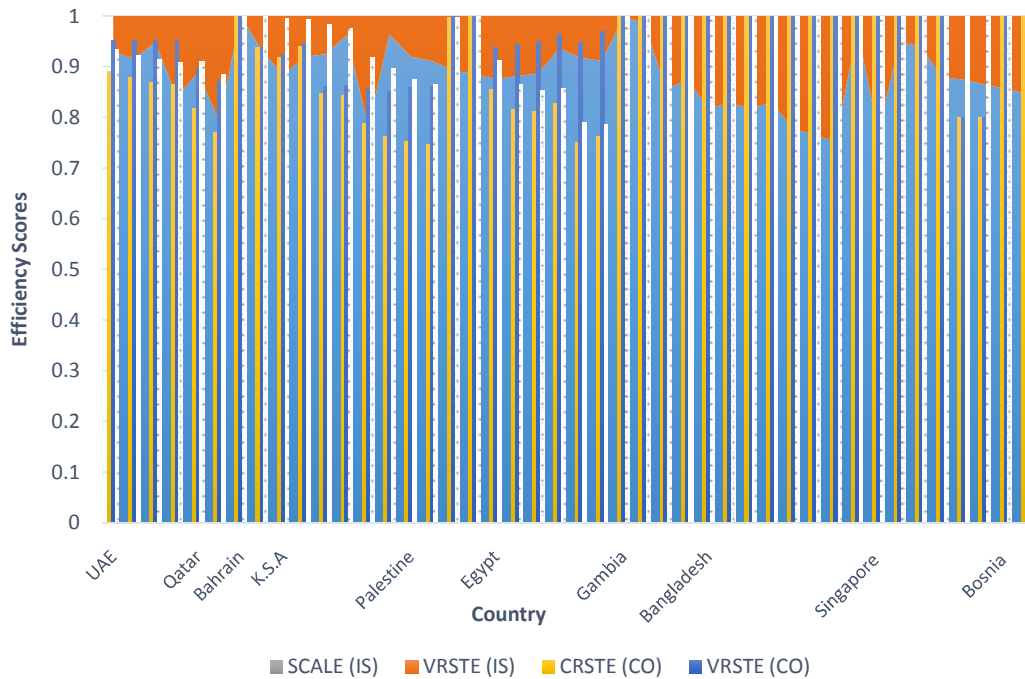


Fig. 3. Average efficiency performance of Islamic and conventional banks - country base

Table 4. Average efficiency performance of Islamic and conventional banks pre-during, and post the crisis of 2008

Time window	Period	Efficiency scores	
		Islamic banks	Conventional banks
Pre-Crisis	2005	0,896	0,948
	2006	0,942	0,954
	2007	0,943	0,962
Average T. Window	2005-2007	0,927	0,955
During-Crisis	2008	0,944	0,954
	2009	0,955	0,948
	2010	0,99	0,942
	Average T. Window	2008-2010	0,963
Post-Crisis 1	2011	0,99	0,945
	2012	0,991	0,946
	2013	0,992	0,946
Average T. Window	2011-2013	0,991	0,946
Post-Crisis 2	2014	0,993	0,947
	2015	0,995	0,958
Overall Average	2016	0,998	0,965
	2005-2016	0,969	0,951

Table 5. Results of the sample t-tests for the entire period

Group	Obs	Mean	S. E.	S. D.	[95%CI]	
Islamic banks	520	0.97	0.00	0.03	0.96	0.97
Conventional banks	528	0.95	0.00	0.06	0.94	0.95
Combined	1048	0.96	0.00	0.05	0.96	0.96
Diff		0.02	0.00		0.01	0.02
Ho: diff = 0						
t = 6.0015						
degrees of freedom =		1046				
Pr(T > t) = 0.0000						

Obs=observation, SE= standard error SD= standard deviation, CI= confidence interval

From the results presented in the mean column, it was established that the efficiency performance of the Islamic banks (0.97) is greater compared to that of the conventional banks (0.95). The difference of the means is significant as shown in the table whereby the p-value (.00) is less than 0.05. Accordingly, the researcher rejects the basic null hypothesis, which is often stated as $H_0: \mu_1 = \mu_2$ in favour of the alternative $H_a: \mu_1 > \mu_2$ which is chosen according to the nature of our study. *The results confirm the hypothesis that;*

H_{1A} : *Islamic banks have better efficiency performance than conventional banks.*

The researcher can conclude with 95% confidence that the efficiency performance of the Islamic banks is better than the conventional banks. In other words, Islamic banks tend to have significantly higher efficiency scores than do conventional banks. Therefore, the upward trend on Islamic banks performance and, on

average, the slightly stronger resilience during the financial crisis showed by Islamic banks is statistically significant enough to proof the superiority in performance as compared to conventional banks. The results are consistent with the findings by Miah and Uddin [80], and Zehri and Mbarek [81] that Islamic banks are more efficient than conventional banks. In addition, other scholars are confident that there is a fast growth and development in the Islamic banks compared to the conventional banks because the former dominate in nations in which the Muslims' population is dominant and predominant [82].

An analysis was also done to determine the efficiency performance of the two types of banks for the period before the crisis (between 2005 and 2007), during the crisis (2008-2010), and post crisis (2011-2013). Table 6 below shows the results of the t-test based on groups of the type of banks on the equality of means of the

Table 6. Results of the t-tests for the pre-financial crisis period of 2008

Group	Obs	Mean	S.E.	S.D.	[95%CI]	
Islamic banks	124	0.97	0.00	0.02	0.96	0.97
Conventional banks	132	0.95	0.01	0.06	0.94	0.96
Combined	256	0.96	0.00	0.05	0.95	0.96
Diff		0.017869	0.005727		0.00659	0.029147

diff = mean(0) - mean(1)
 Ho: diff = 0
 t = 3.1201
 degrees of freedom= 254
 Pr(|T| > |t|) = 0.0020

Obs=observation, SE= standard error SD= standard deviation, CI= confidence interval

Table 7. Results of the t-tests during financial crisis period of 2008

Group	Obs	Mean	S.E.	S.D.	[95%CI]	
Islamic banks	132	0.97	0.00	0.03	0.96	0.97
Conventional banks	132	0.95	0.01	0.06	0.94	0.96
Combined	264	0.96	0.00	0.05	0.95	0.96
Diff		0.02	0.01		0.01	0.03

t = 2.9458
 degrees of freedom= 262
 Pr(|T| > |t|) = 0.0035

Obs=observation, SE= standard error SD= standard deviation, CI= confidence interval

Table 8. Results of the t-tests post-financial crisis period of 2008

Group	Obs	Mean	S.E.	S.D.	[95%CI]	
Islamic banks	132	0.97	0.00	0.03	0.96	0.97
Conventional banks	132	0.95	0.01	0.06	0.94	0.96
Combined	264	0.96	0.00	0.05	0.95	0.96
Diff		0.02	0.01		0.01	0.03

t = 2.9458
 degrees of freedom=262
 Pr(|T| > |t|) = 0.0035

Obs=observation, SE= standard error SD= standard deviation, CI= confidence interval

efficiency performance for the pre-financial crisis period of 2008. The results indicate that the means of the efficiency performance of the Islamic banks (0.97) is greater compared to that of the conventional banks (0.95). The difference of the means is significant as shown in the table whereby the p-value (.002) is less than 0.05, therefore, the researcher can conclude with 95% confidence that the efficiency performance of the Islamic banks in the pre-financial crisis of 2008 was better than the conventional banks.

Table 7 illustrates the results of the t-test of the equality of means of the efficiency performance based on the type of banks during the financial crisis period of 2008. The results indicate that the means of the efficiency performance of the

Islamic banks (0.97) is greater compared to that of the conventional banks (0.95). The difference of the means is significant as shown in the table whereby the p-value (.0035) is less than 0.05, therefore, the researcher can conclude with 95% confidence that the efficiency performance of the Islamic banks during the financial crisis of 2008 was better than the conventional banks.

Table 8 below illustrates the results of the t-test of the equality of means of the efficiency performance based on the type of banks during the post-financial crisis period of 2008. The results demonstrated that the means of the efficiency performance of the Islamic banks (0.97) is greater compared to that of the conventional banks (0.95). The difference

between the means is significant as shown in the table whereby the p-value (.0035) is less than 0.05. As such, the researcher can conclude with 95% confidence that the efficiency performance of the Islamic banks during the post financial crisis of 2008 was better than the conventional banks.

The results of the two-sample *t*-test for equal means for the three sub periods, pre-crisis (2005-2007), during the crisis (2008-2010), and post-crisis (2011-2013) confirm the hypothesis that; *H_{1B}: Islamic banks had better efficiency performance than conventional banks pre, during, and post financial crisis of 2008.*

The results are consistent with the findings by El Rifai [83] that there is always a significant difference in the financial performance between the two banking systems; Islamic and conventional banks. Also, the results are supported by the findings by Hadriche [84] that Islamic banks are more efficient on average compared to conventional banks. Moreover, the test has provided a significant evidence that efficiency scores for Islamic banks are superior to those of conventional banks for the periods (2005-2010), (2005-2008), (2011-2013), and (2005-2016). This means that Islamic banks are less vulnerable to financial shocks. Findings are inconsistent with those revealed by Abdul [85]. But support the results revealed by Alamer et al. [23].

5. CONCLUSIONS

This paper was set out to provide estimates of Islamic versus conventional banks' efficiency performance. It also aims to compare the efficiency estimates of Islamic banks from UAE, Qatar, Bahrain, K.S.A, Egypt, Malaysia, Thailand, Turkey, Singapore, Jordan, Palestine, Bangladesh, Pakistan, Sudan, Yemen, Syria, Gambia, Iran, U.K, and Bosnia using DEA during 2005–2016. The measured efficiency of selected banks was compared according to region, bank and year of operation. Data were collected from both Orbis Bank Focus database and banks financial statements for the 44 sample Islamic banks and 44 conventional banks to measure the respective efficiency scores.

Findings show that all banks' average efficiency scores were almost smaller than 1 throughout the entire period from 2005 to 2016. Inefficiencies are mainly due to the inappropriate size of banks' operations. Accordingly, Islamic

and conventional exhibited a decreasing return to scale thus, can improve efficiency by shrinking down banking activities. Poor management practices contribute also partially to banks' low efficiency scores. Yet, Islamic banks seem to have on average a significant better efficiency performance than conventional banks during the entire period, pre-crisis, crisis, and post-crisis periods. They are better than conventional banks in employing banks' inputs (total deposits and short-term funding, other operating expenses, and personal or administrative expenses) to generate higher quantity of outputs (net income and total loans). Islamic banks have also lower volatility on their efficiency scores and have a proper room for improvement by using fewer resources than they employed or by controlling costs to sustain a competitive substantial advantage in the financial markets.

Eventually, the observable relative immunity of Islamic finance to the adverse effects of the global financial crisis of 2008 led to the growing interest of local and international investors in Islamic finance to diversify their investments risk. As a result, a new business model for the international banking system based on shari'ah law transactions should be in practice to encourage business activities which could help in financing businesses to induce economy and link financial expansion to the growth of the economy.

5.1 Limitations and Suggestions for Future Research

Limitations are very common for many studies. This study is not an exception, therefore, has certain limitations. Firstly, there remains no consensus on the number of key players of world Islamic banks. Consequently, it is difficult to determine the actual number of Islamic banks around the world. Accordingly, this study is limited to banks' financial data available in Orbis Bank Focus database. Secondly, Islamic banks are still new thus finding a "comparable counterpart conventional banks" for Islamic banks has its limitations, as it is not easy to develop a matching covering all the characteristics fully. Eventually, sampling mostly Muslim dominated countries where Islamic banking is acceptable may account for their efficiency. Therefore, findings for all researches in this area need further efforts and analysis.

Moreover, the researcher gives some references to studies, which stated the vital role that Islamic

banking sector plays in countries' economic growth. Therefore, to further examine differences in Islamic banks and conventional banks performance on their effect on economy, the researcher could model the relationship between banks performance and economic growth proxied by GDP. To do so, the researcher suggests applying regression analysis to examine the direction of the relationship between the two variables. Moreover, to make the suggested regression model more reliable, the researcher suggests also adding some control variables (banks-internal factors) to the model to examine if such factors play any role on the direction and the strength of the relationship between banks performance and economic growth. This will yield some additional insights and would be a completely new paper.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ernst, Young. The World Islamic Banking Competitiveness Report 2014-2015; 2016. Available:<http://www.ey.com/em/en/industries/financial-services/banking---capital-markets/ey-world-islamic-banking-competitiveness-report-2014-15> (Accessed on 17.04.2018)
2. Thomson Reuters. State of the Global Islamic Economy Report 2016/17-Dubai; 2017. Available:<https://ceif.iba.edu.pk/pdf/ThomsonReuters-stateoftheGlobalIslamicEconomyReport201617.pdf> (Accessed on 17.04.2018)
3. Ahmed H. Contribution of Islamic Finance to the. 2030 Agenda for Sustainable Development. Durham University, United Kingdom. (2017). Available at: www.un.org/esa/ffd/high-level-conference-on-ffd-and-2030-agenda/wp-content/uploads/sites/4/2017/11/Background-Paper_Islamic-Finance.pdf
4. Standard & Poor's report. Islamic finance growth to lose momentum; 2018. Available:<http://saudigazette.com.sa/article/180940/Islamic-finance-growth-to-lose-momentum-in-2018-S-P-report>
5. Aliyu S, Hassan K, Yusof RM, Naiimi N. Islamic banking sustainability: A review of literature and directions for future research. *Emerging Markets Finance and Trade*. 2017;53(2):440-470. DOI: 10.1080/1540496X.2016.1262761
6. Ahmad Z, Abdul Majid NH. Islamic bank financing, financial crisis and monetary policy in Malaysia: An interaction in the long run equilibrium. *International Journal of Islamic Business*. 2017;2(1):15-23.
7. Askari H, Iqbal Z, Mirakhor A. New issues in islamic finance and economics: Progress and challenges. *Wiley Finance-Islamic Finance*; 2015.
8. Amilin A, Ismail T, Astuti S, Reskino Mulazid AS. Islamic work ethics and organizational justice implementation in reaching accountants' job satisfaction. *Academy of Accounting and Financial Studies Journal*. 2018;22(1):1-11.
9. El-Gamal MA. Law, economics, and practice. Cambridge University Press, UK; 2006.
10. Franzoni S, Allali AA. Principles of islamic finance and principles of corporate social responsibility: What convergence? *Sustainability*, MDPI. 2018;10:637. DOI: 10.3390/su10030637 Available:www.mdpi.com/journal/sustainability
11. Olichwier S. The rise of Islamic finance. B & R Beurs, Erasmus Investment Society; 2018. Available:<https://www.bnrbeurs.nl/2018/03/07/the-rise-of-islamic-finance/> (Accessed on 18.04.2018)
12. Standard & Poor's Global. Islamic Finance Outlook; 2017. Available:<https://www.spratings.com/documents/20184/0/Islamic+Finance+Outlook+2017/5abbe572-c826-4622-bd13-1aba725281fc> (Accessed on 18.04.2018)
13. Pew Research Center. The future of world religions: Population growth projections, 2010-2050; 2015. Available:<http://www.pewforum.org/2015/04/02/religious-projections-2010-2050/>
14. Economist Magazine. Islamic finance: Big interest. No Interest; 2014. Available:<http://www.economist.com/news/finance-and-economics/21617014-market-islamic-financial-products-growing-fast-big-interest-no-interest>
15. Bank Negara Malaysia Annual report. Europe: A rising opportunity for Islamic Finance. MIFC Publication; 2015.

16. Burton L. City urges Government to prioritize Islamic finance ahead of possible Brexit boom; 2017. Available:<http://www.telegraph.co.uk/business/2017/09/11/city-urges-government-prioritise-islamic-finance-ahead-possible/>
17. Grira J, Hassan MK, Soumare I. Pricing beliefs: Empirical evidence from the implied cost of deposit insurance for Islamic banks. *Economic Modelling*. 2016; 55:152–168.
18. Arouri MEH, Ben Ameer H, Jawadi N, Louhichi W. Are Islamic finance innovations enough for investors to escape from a financial downturn? Further evidence from portfolio simulations. *Applied Economics*. 2013;45(24):3412–3420.
19. Jobst A. The economics of Islamic finance and securitization. *Journal of Structured Finance*. 2007;13(1):6-27.
20. Errico L, Sundararajan V. Islamic financial institutions and products in the global financial system: Key issues in risk management and challenges ahead. *IMF Working Papers*. 2002;1-27. Available:<https://ssrn.com/abstract=1930788>
21. Samad A, Hassan M. The performance of Malaysian Islamic bank during 1984–1997: an exploratory study. *International Journal of Islamic Financial Services*. 1999;1(3)1–14.
22. Abduh M, Chowdhury NT. Does Islamic banking matter for economic growth in Bangladesh? *Journal of Islamic Economics, Banking and Finance*. 2012; 8(3):104–113.
23. Alamer ARA, Salamon HB, Qureshi MI, Rasli AM. CSR's measuring corporate social responsibility practice in Islamic banking. *International Journal of Economics and Financial Issues*. 2015; 5(1S):198-206.
24. Kassim S. Islamic finance and economic growth: The Malaysian experience. *Global Finance Journal*. 2016;30(C):66-76.
25. Khan A, Shah AQ. A comparative analysis of regulatory and supervisory Islamic banking: Evidence from Pakistan, Malaysia, Bahrain, and the UK. *The Lahore Journal of Business*. 2015;4(1):37–60.
26. Metwally M. Differences between the financial characteristics of interest-free banks and conventional banks. *European Business Review*. 1997;9(2):92–98.
27. Rosly SA, Abu Bakar MA. Performance of Islamic and mainstream banks in Malaysia. *International Journal of Social Economics*. 2003;30(12):1249-1265.
28. Samad A. Performance of interest-free Islamic banks vis-a-vis interest-based conventional banks of Bahrain. *IJUM Journal of Economics and Management*. 2004;12(2):1-15.
29. Kader JM, Asarpota AK. Comparative Financial performance of Islamic vis a vis conventional banks in the UAE. Paper presented at 2006-2007 Annual Student Research Symposium & First Chancellor's Undergraduate Research Award at UAE University; 2007.
30. Čihák M, Hesse H. Islamic banks and financial stability: An empirical analysis. *IMF Working Paper No. 08/16*. Washington: International Monetary Fund; 2008.
31. Moin MS. Financial performance of Islamic and conventional banking in Pakistan: A comparative study. *International Journal of Innovative and Applied Sciences*. 2013; 1(1):1-22.
32. Khan I, Khan M, Tahir M. Performance comparison of Islamic and conventional banks: Empirical evidence from Pakistan. *International Journal of Islamic and Middle Eastern Finance and Management*. 2017; 10(3):419-433
33. Limam I. Measuring technical efficiency of kuwait banks. *API-Working Paper Series 0101*, Arab Planning Institute -Kuwait, Information Center; 2001. Available:<http://www.arab-api.org/wps/wps0101.htm>
34. Hussein KA. Operational efficiency in islamic banking: The sudanese experience. Working Paper No. 1. Islamic Research and Training Institute (IRTI), Islamic Development Bank; 2003.
35. Majid MA, Nor NGM, Said FF. Efficiency of banks in Malaysia. In *Proceedings of the Fifth International Conference on Islamic Economics and Finance*. Bahrain. 2003;2: 405-6.
36. Yudistira D. Efficiency in Islamic banking: An empirical analysis of eighteen banks. *Islamic Economic Studies*. 2004;12(1):1–19.
37. Hassan K. The cost, profit and x-efficiency of Islamic banks. Presented at ERF's (Economic Research forum) 12th Annual Conference, Cairo, Egypt; 2005.

- Available:http://www.erf.org.eg/CMS/uploads/pdf/1184492515_Kabir_Hassan.pdf
38. Mokhtar H, Abdullah N, Al- Habshi SM. Efficiency of Islamic banking in Malaysia: A stochastic frontier approach. *Journal of Islamic Corporation*. 2006;2:37–70.
 39. Sufian F. Malmquist indices of productivity change in Malaysian Islamic banking industry: Foreign versus domestic banks. *Journal of Economic Corporation*. 2007; 28(1):115-150.
 40. Johnes J, Abdu Izzeldin M, Pappas V. Efficiency in Islamic and conventional banks: A comparison based on financial ratios and data envelopment analysis. WP from Lancaster University Management School; 2007. Available:<http://www.lums.lancs.ac.uk/files/Efficiency.pdf>
 41. Kamaruddin BH, Safa MS, Mohd R. Assessing production efficiency of Islamic banks and conventional bank Islamic windows in Malaysia. *International Journal of Business and Management Research*. 2008;1(1):31-48.
 42. Bader MK, Mohamad S, Ariff M, Hassan T. Cost, revenue and profit efficiency of Islamic versus conventional banks: International evidence using DEA. *Islamic Economic Studies*. 2008;15(2):24–76.
 43. Mokhtar A, Abdullah HSN, Alhabshi SM. Efficiency and competition of Islamic banking in Malaysia. *Humanomics*. 2008; 24(1):28-48.
 44. Abd-Majid MS, Kassim SH. Impact of financial shocks on Islamic banks: Malaysian evidence during 1997 and 2007 financial crises. *International Journal of Islamic and Middle Eastern Finance and Management*. 2010;3:291-305.
 45. Kablan S, Yousfi O. Efficiency of Islamic and conventional banks in countries with Islamic banking. MPRA Paper No. 32951; 2011.
 46. Qureshi MA, Shaikh M. Efficiency of Islamic and conventional banks in Pakistan: A nonparametric approach. *International Journal of Business and Management*. 2012;7(7):40-50.
 47. Ajlouni MM, Omari HO. Performance efficiency of the Jordanian Islamic banks using data envelopment analysis and financial ratios analysis. *European Scientific Journal*. 2013;1:271-281.
 48. Abdul Rahman AR, Rosman R. Efficiency of Islamic banks: A comparative analysis of MENA and Asian countries. *Journal of Economic Cooperation & Development*. 2013;34(1):63-92.
 49. Saeed S, Ali F, Adeeb B, Hamid M. Examining efficiency of Islamic and conventional banks in Pakistan: Using data envelopment analysis. *Global Journal of Management and Business Research Finance*. 2013;13(10)(Version 1).
 50. Said R, Daud MM, Radjeman LA, Ismail N. Probing corporate ethical identity of Shari'ah compliant companies. *Procedia Economics and Finance*. 2013;7:230-235.
 51. Zuhroh I, Ismail M, Maskie G. Cost efficiency of Islamic banks in Indonesia – A stochastic frontier analysis. *Procedia - Social and Behavioral Sciences*. 2015; 211:1122–1131.
 52. Yilmaz MK, Sensoy A, Ozturk K, Hacıhasanoglu H. Cross-sectoral interactions in Islamic equity markets. *Pacific Basin Finance Journal*. 2015;32:1-20.
 53. Bukhari MSS, Harrathi N. Bank Efficiency analysis: Islamic banks versus conventional banks in the Gulf Cooperation Council Countries 2006 – 2012. *International Journal of Financial Research*. 2015;6(4):143-150.
 54. Romdhane M, Alhakimi SS. Productivity and technical efficiency in Islamic banks: Cross - country analysis. *Asian Journal of Economic Modelling*. *Asian Economic and Social Society*. 2018;6(1):1-7.
 55. Violeta C, Gordana S. Efficiency of bank branches: Empirical evidence from a two-phase research approach, *Economic Research-Ekonomska Istraživanja*. 2017; 30(1):318-333.
 56. Iqbal M, Molyneux P. Efficiency in Islamic banking. Thirty years of Islamic banking. Palgrave Macmillan, UK. 2005;88-104.
 57. Svitalkova Z. Comparison and evaluation of bank efficiency in selected countries in EU. *Procedia Economics and Finance*. 2014;12:644–653.
 58. Cooper WW, Seiford LM, Tone K. Data envelopment analysis: A comprehensive text with models, applications, references and dea-solver software. Second Edition, Springer, New York; 2007.
 59. Alirezaee M, Howland M, Panne CVD. Sampling size and efficiency bias in Data Envelopment Analysis. *Journal of Applied Mathematics and Decision Sciences*. 1998; 2(1):51-64.
 60. Darrat AF, Topuz C, Yousef T. Assessing cost and technical efficiency of banks in

- Kuwait. ERF's 8Th Annual Conference in Cairo; 2002.
61. Abu-Alkheil AM, Burghof H-p, Khan WA. Islamic commercial banking in Europe: A cross-country and inter-bank analysis of efficiency performance. *International Business & Economics Research Journal*. 2012;11(6):647-676.
 62. Chen Y, Gregoriou GN, Roudah FD. Efficiency persistence of bank and Thrift CEOs using data envelopment analysis. Chapter 1 in Paradi, J., Tam, F. K. & Sherman, H. D. *Data Envelopment Analysis in the Financial services industry: A Guide for Practitioners and Analysts Working in Operations Research Using DEA*. eBook, Springer International Publishing; 2018.
 63. Charnes A, Cooper WW, Rhodes E. Measuring the efficiency of DMUs. *European Journal of Operational Research*. 1978;2:429-444.
 64. Yang SH. Using blogs to enhance critical reflection and community of practice. *Educational Technology & Society*. 2009; 12(2):11–21.
 65. Coelli T. A guide to FRONTIER version 4.1: A computer program for stochastic frontier production and cost function estimation. CEPA Working Paper 96/08; 1996. University of New England Available:<http://www.uq.edu.au/economics/cepa/frontier.php>
 66. Young S, Milan Z, Lung Y. *New frontiers of decision making for the information technology era*. Singapore; World Scientific; 2000.
 67. Zhu J. *Quantitative models for performance evaluation and benchmarking: Data envelopment analysis with spreadsheets*. Springer International Publishing; 2014.
 68. LaMorte WW. When to use a nonparametric test. Boston University School of Public Health; 2017. Available:http://sphweb.bumc.bu.edu/otlt/MPHModules/BS/BS704_Nonparametric/BS704_Nonparametric2.html
 69. Dilts DM, Zell A, Orwoll E. A novel approach to measuring efficiency of scientific research projects: Data envelopment analysis. 2015;8(5):495–501.
 70. Pedraja-Chaparro F, Salinas-Jimenez J, Smith P. On the quality of the data envelopment analysis model. *Journal of the Operational Research Society*. 1999; 50:636-644.
 71. Boussofiane A, Dyson G, Thanassoulis E. *Applied data envelopment analysis European Journal of Operational Research*. 1991;52:1-15.
 72. Ueda T, Hoshiai Y. Application of principal component analysis for parsimonious summarization of DEA inputs and/or outputs. *Journal of the Operational Research Society of Japan*. 1997;40:466-478.
 73. Lønborg R. Regulation, organization and efficiency: Benchmarking of publicly and privately owned utility companies. The 3rd ECPR Conference. Budapest 8th-10th of Sep; 2005. Available:<http://regulation.upf.edu/ecpr-05-papers/rlonborg.pdf>
 74. Francisco JL, Johnny CH, Alex JRT. A computational analysis of the impact of correlation and data translation on DEA efficiency scores. *Journal of Industrial and Production Engineering*. 2016;33(3):192-204.
 75. Abdul Majid M, Md. Nor, NG, Said FF. Efficiency of Malaysian banks: What happened after the financial crisis? paper presented at the National Seminar on Managing Malaysia in the Millennium: Economic and Business Challenges, Universiti Teknologi Mara and Melaka State Government, Malaysia. 2003;1-2.
 76. Afiatun P, Wiryono SK. Efficiency and productivity of Indonesian Islamic banking. *Journal Manajemen Teknologi*. 2010;9(3): 264-278.
 77. Milhem MM, Istaiteyeh RMS. Financial performance of Islamic and conventional banks: Evidence from Jordan. *Global Journal of Business Research*. 2015;9(3): 27-41.
 78. Tlemsani I, Alsuwaidi H. Comparative analysis of Islamic and conventional banks in the UAE during the financial crisis. *Asian Economic and Financial Review*. 2016; 6(6):298-309.
 79. Amry AB. The impact of whatsapp mobile social learning on the achievement and attitudes of female students compared with face to face learning in the classroom. *European Scientific Journal, ESJ*. 2014;10(22):116-136. Available:<http://eujournal.org/index.php/esj/article/view/3909>
 80. Miah MD, Uddin H. Efficiency and stability: A comparative study between Islamic and conventional banks in GCC countries.

- Future Business Journal. 2017;3(2):172-185.
81. Zehri F, Mbarek NB. Banks' performance in KSA during financial distress: A comparative study islamic and conventional banks. *Arabian J. Bus. Manag. Review*. 2016;S1:009.
82. Pradiknas TY, Faturohman T. Efficiency of islamic banking compared to the conventional banking: Evidence from Indonesian banking sector. *Journal of Business and Management*. 2015;4(5): 540-551.
83. El Rifai O. Financial performance of Islamic Banks vs. Conventional Banks: The Case of UAE. Thesis (M.S.). (2016): Eastern Mediterranean University, Faculty of Business and Economics, Dept. of Banking and Finance.
84. Hadriche M. Banks performance determinants: Comparative analysis between conventional and Islamic banks from GCC Countries. *International Journal of Economics and Finance*. 2015;7(9): 169.
85. Abdul-Majid M, Saal DS, Battisti G. Efficiency in islamic and conventional banking: An international comparison. *Journal of Productivity Analysis*. 2010; 34(1):25-43.

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