A meta-crisis banking efficieny study in the MENA region

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1. Introduction

Over the past two decades, shariah-compliant banking has seen global growth rates of approximately 10-15 percent per annum (Thomson Reuters, 2017). The G.C.C region alone accounts for nearly half (43.7%) of global Islamic banking assets while its total worth has surpassed the $2 trillion mark (IFSB, 2018). Both academics and regulators, have exemplified some of the attractions of Shariah-designed financial products in terms of safeguarding financial stability (El Qorchi, 2005; Luca and Farahbaksh, 1998). They have, for example, pointed to the asset-liability mismatch mitigation problem of short-term deposits through equity and risk-sharing. In a very recent projection survey (Thomson Reuters, 2017) global Islamic assets are forecasted to be in excess of $3.5 trillion by 2021. This projected asset growth is poised to be even more influential in a slow global growth environment. IFSB (2017) reports that the average growth rate has slowed down from its previous rates of approximately 8.5% over the period 2009-2016 owed partly to post-crisis regulation. At the same time, other highly topical, professional and academic research, counter-argue the latter argument above (Ariss, 2010; S&P, 2016; Bitar et al., 2017). They reason that the pace of Islamic asset growth is expected to actually accelerate in the next decade and, to a certain extent, will be compensated for by penetration and growth in 'non-core' markets (i.e. Europe, Russia, and Africa) and bolster the Islamic bond market (sukuk) (S&P, 2017; Dubai Islamic Bank 2017a; 2017b). In support, recent research argues that the UK, the largest money market in Europe, post-Brexit will lose assigned EU funding for some of its infrastructure and regeneration projects and will therefore be seeking alternative funding sources. The UK can likely turn to Islamic finance to substitute some lost EU funding, given its growing interest in Shariah-compliant funds (Burton, 2017; Vizcaino and Cohn, 2017; Harrison, 2018).

Islamic financing penetration may scale even higher as well as synchronise with conventional banking services. It has also been argued that G.C.C banks are continuously hunting for new sources of boosting up their tier 1 capital in order to support asset growth and foreign expansion. Furthermore, they seek to increase their loss absorbing capacity as they become more correlated with western economies (Trabelsi and Trad, 2017). This is the result of a co-ordinated response of G.C.C economies to the globalization of financial markets, where the regulatory authorities have implemented financial sector liberalization initiatives in order to enable their economies to compete more effectively with conventional banking markets (Al-Obaidan, 2008; Di Mauro et al., 2013). While growth remains strong among banks in the Gulf banking sector, the liberalisation of the industry also introduces challenges. These revolve mainly around the density of global banking competition and the effects of the last financial crisis on the G.C.C regional economy (Ariss et al., 2007). Such challenges have had an immediate effect on the institutions' key operations, their performance and capacity to grow, diversify and further develop internationally. Opening up to fresh opposition from foreign banks and antagonism from non-bank financial institutions, Islamic banks in the Gulf region improve their productivity by engaging in cost-cutting activities and by adjusting their pricing and the provision of their outputs (Srairi, 2010). Basel III requires banks to increase their capital buffers to improve the systemic stability of global finance, in addition to diversifying the structure of these buffers and their quality. In the aftermath of the crisis and over the last ten years, the concept of Islamic banking has equally advanced to include operations of western financial institutions such as insurance, investment, wealth and fund management. In response to Islamic banking advancements many conventional banks in G.C.C countries have also responded by adding more Islamic banking services to their regular banking operations (Johnes et al., 2018). Hence, the growth rates and the efficiency with which G.C.C banks convert their inputs to outputs is paramount to responding to competitive pressures arising from conventional banking competition. This constitutes our first major research question in this research paper where we aim to examine and compare the cost and revenue efficiency of conventional and Islamic banks. The literature review points to the fact that Islamic banks were seemingly insulated before and amidst the crisis, the effects of which were actually materially shown post-crisis through the lagging of synchronization of economic cycles. This is a further justification for our research where also the countries chosen constitute the major banking markets in the region.

Progressively, the G.C.C region and Islamic finance are assigned a more material role in global finance as well as become increasingly intertwined with conventional finance. The existing literature so far is naturally divided between two phases (pre- and post-crisis phase studies). The earlier part of research puts an emphasis on theoretical enquiry while the later stage studies concentrate mostly on empirical research. Yet, while there is a relatively hefty practitioner research on Islamic banking and finance, the academic research remains scarcer and more fragmented. Research seems to also suggest that global Islamic banking *'can no longer claim to be superior to conventional banking in all the stability dimensions'* (IFSB, p.4, 2018). Islamic banks seem to outperform European Union (EU) banks in terms of return on assets (ROA) and return on equity (ROE) as well as efficiency (for example cost-to-income). On some other dimensions though, the capitalization of EU banks seems now stronger than ever and well above that of Islamic banks (Belouafi et al., 2018). A further objective of this paper is to examine some of the determinants of cost and revenue efficiency among Islamic and conventional banks. This is our second main research question.

During the last two decades, an extensive literature has been built on the cost and profit efficiency of financial institutions in the competitive banking markets of Western Europe and North America (see for example Berger and Humphrey, 1997). Overall, the research finds that while there seem to be cost, revenue and profit efficiency improvements related to competition, regulation and market depth, the variety and plurality of efficiency tests and methods do not produce consistent results (Barth et al., 2001; Barth et al., 2013).There has also been related research regarding individual countries and their respective financial systems that go through a transition phase, most notably Eastern European markets and economies (Fries and Taci, 2005; Bonin et al., 2005; Kasman and Yildirim, 2006; Mamatzakis et al., 2008). Yet, regional institutions may gradually become systemically more relevant and increasingly interact with systemically important conventional banks. Examining and understanding Islamic bank efficiency is thus essential from both an academic and a financial stability perspective. Importantly, there is a limited amount of similar, modern research devoted exclusively on Gulf-based countries by comparison (Cham, 2018; Alharbi 2017; Trabelsi and Trad, 2017). We further aim to add the literature review by updating and providing a comparative pre-/post-crisis literature search and discussion.

This paper contributes to the existing literature in three ways. First, with regard to output efficiency we examine the often-overlooked benchmark of revenue efficiency as a further major contribution. The reason is that a key barrier to a bank's profits is/are the compartmentalized models where product homogeneity for Islamic banking is fractured and therefore diversification is very important. In addition, diversification gains can potentially, partially at least be cancelled out, through volatile non-interest related income activities. Second, we contribute an empirical study that examines revenue and cost efficiency of *both* commercial and Islamic banks concentrating exclusively in the Gulf region post-crisis where we utilise the most recent data available. Third, such literature is updated in a structured manner where we also update and provide for a targeted, structured literature review pre and post-crisis.

The rest of the paper is structured as follows: In section 2 we review the current literature in Islamic banking. In particular, and for the purposes of a structured approach and clarity we discuss separately the pre- and post-crisis literature in two sub-sections. We conclude section 2 with a paragraph that summarises the comparison between pre- and post-crisis studies. Section 3 discusses our methodology and data where we provide our reasoning for applying a non-parametric technique (DEA), to our data analysis. In Section 4, we present the data analysis and discuss the results obtained. Finally, section 5 concludes and provides suggestions for future research.

2. Literature Review

2.1 Pre-Crisis Studies Literature

Starting at the turn of the century, research related to Islamic banking initially followed a small scale, single country focus orientation before evolving to larger, country-panel data sets. As early as 1989,

research studying Islamic banking in Sudan, found Islamic banks across the industry to be both technically and allocatively inefficient with an overall *'worrisome inefficiency of 28%'* (Saaid at al., 2003, p.137). In Kuwaiti banking, utilising a Stochastic Frontier Approach (SFA), results pointed towards an average cost efficiency of 91% for all banks (Limam, 2001).

In the same exactly setting, covering the 1994-1997 period, other research studying cost and technological efficiencies by utilising DEA finds some contrasting results. Cost efficiency of Kuwaiti banks averaged just about 68% pointing out that the greatest sources of inefficiency are those of regulatory (allocative) and technical (managerial) inefficiencies (Darrat, et al., 2003). In Tunisian banking, results show that banks have an overall profit efficiency level of 86% following financial liberalisation in the noughties (Islam, 2003a). In Jordan, covering (1993-2004), results have revealed substantial deviations of banks from their optimal frontier; the estimated levels of efficiency across banks overall showed lower means of cost and profit efficiency (Al-Fayoumi and Alkour, 2008). Other studies examining Islamic banks find that their operations are largely characterized by good and stable asset quality, high levels of profitability and provide for satisfactory liquidity (Islam, 2003b; Eltony, 2003).

Cross-country, panel studies show that for the Middle East and North Africa region (MENA) financial development varies across the region with notable variations among banking sectors and regulatory and supervisory regimes (Creane et al., 2004). Grigorian and Manole (2005), provide evidence of competitiveness in terms of scale efficiency in a comparative study between Singaporean and Bahrain banks yet they observe that Arab banks still lagged behind their 'westernised' counterprarts. Ariss et al. (2007) studied 45 banks operating in the six GCC countries (for 1999–2004) and found an average overall efficiency score of about 78% for all banks in GCC countries noting also a decline in the overall efficiency index for the same period. They attribute the decrease in allocative rather than technical efficiency. In the same exactly setting, over the same period, other research provides contrasting results. Banks in four of the six GCC countries (Bahrain, Kuwait, Saudi Arabia, and the UAE) registered progress in terms of productive efficiency during 2000–2004 (Ramanathan, 2007). Lepetit et al. (2008) find that the higher the income share from commissions and fees the lower the association between margins and loan spreads is. Furthermore, the higher the fee income-sharing and risk-sharing the weaker the link between bank loan spreads and loan risk. Srairi (2010) finds that banks in the Gulf region are relatively more efficient at generating profits than at controlling costs with conventional banks being on average more efficient than Islamic banks. They conclude with the observation of a positive correlation of cost and profit efficiency with bank capitalization and profitability, and a negative correlation with operational costs. Higher loan activity is positively correlated with profit efficiency of banks, but negatively associated to cost efficiency (Srairi, 2010).

On a competitive level, Apergis and Polemis (2016) empirically assess the relationship between competition and efficiency in the banking sector of Middle East and North African (MENA) countries spanning the period 1997–2011 and they find that increases in competition do not precede increases in cost efficiency. Abid and Goaied (2017) study profit efficiency on the MENA region on comparative competition levels from 1991 to 2011. Their findings support that profit efficiency varies from one country to another, and the technological gap among countries plays an important role in explaining the ability of the banking sector in one country to compete with others. Al-Jarrah et al. (2017) estimate the cost-efficiency levels for conventional and Islamic, Cooperation Council (GCC) and non-GCC banks in the Middle East and North African (MENA) countries. They conclude that the observed efficiency scores for both conventional commercial and Islamic banks are comparable and are positively correlated with the market share, the market concentration and the bank size. They attribute these results to intense competition between the two sets of banks as well as the fact that Islamic banks are strongly supported by a stable base of faith-oriented clients. Another research paper that compares the efficiency of MENA banks with a large group of international banking systems for 2002-2012 suggests that managerial efficiency could be the driver to improve technology efficiency in the region conditional on the availability of high qualified human capital in the banking sector (Chaffai and Coccorese, 2019). González et al. (2019) examine market structure, profitability, and efficiency using

a dynamic panel data for 201 banks in Middle East and North Africa (MENA) countries during the 2005–2012 period. Their results provide evidence that cost efficiency has a significant effect on bank profitability. They also find evidence for the relative market power hypothesis, suggesting that banks with higher market share obtain higher profits by setting higher prices. The latter point though is also adversely affected by concentrated markets with more profitable and less efficient banks.

2.2 Post Crisis Studies Literature

Following the latest financial crisis there have been calls for the regulators to consider the attractions of Islamic banking in terms of efficiency, risk management and financial stability. Some researchers have argued that it is the very absence of adequate market discipline in the financial system that tends to promote excessive lending, high leverage, speculation, risk loading and an unsustainable rise in asset prices (Chapra, 2011). Abedifar et al. (2013) find that Islamic banks based in countries with predominantly Muslim populations have lower credit risk than conventional banks. Čihák and Hesse (2010), examine the competition between Islamic versus conventional banks and financial stability and find that, (i) small Islamic banks tend to be financially stronger than small commercial banks; and (ii) small Islamic banks tend to be financially stronger than large Islamic banks, which may reflect higher management efficiency.

Imam and Kpodar (2013) find that Islamic banks complement conventional banks and cater to different investor and depositor needs. Studies in the G.C.C region show that there are significant differences between conventional and Islamic banks in terms of how revenue and profit efficiency interact. Revenue efficiency seems to be important only for the Islamic group of banks (Khediri et al., 2015). Kamarudin et al. (2014) find that on average Islamic banks are more profitable, more liquid, better capitalized with lower credit risk than conventional banks. The authors argue that the two types of banks can be differentiated in terms of credit and insolvency risk, operating leverage and off-balance sheet activities, but not in terms of their profitability and liquidity. Bourkhis and Nabi (2013) argue that the last global financial crisis induced a series of failures of many conventional banks and this in turn led to an increased interest in the Islamic banking business model. Their study showed though no significant difference in terms of the effect of the financial crisis on the soundness of both Islamic and conventional banks.

A study comparatively examining the efficiency of Islamic versus conventional banks in Europe shows that Islamic banks are technically more efficient than conventional banks but are beset by lower allocative efficiency. Islamic banks have lower cost efficiency in comparison to the more conventional banks in Europe (Ahmad and Luo, 2010). Ariss (2010) examines the competitive conditions prevailing in Islamic and conventional global banking markets in terms of profitability. Results suggest that while Islamic banks allocate a greater share of their assets to financing activities compared to conventional banks, Islamic banking is less competitive compared to conventional banking. An interesting, two-fold insight from related research is the following: first, competition suppresses profit margins, and results in reduced franchise value that encourages bank risk taking and secondly, even if market power in the loan market results in riskier loan portfolios, the overall risks of banks need not necessarily increase if banks protect their franchise values by increasing their equity capital and strengthening their liquidity base (Berger et al., 2009). This has implications for Islamic bank capital levels considering the full adoption of Basel III in that Islamic banks will face challenges meeting their capital and liquidity needs (Ahmed, 2015). Alqahtani and Mayes (2018) find that the difference between Islamic and conventional banks' financial performance and stability was not significant during the crisis. Islamic banks suffered more in the later phases of the financial crisis with small Islamic banks demonstrating a comparatively more efficient handling of the crisis than large Islamic banks.

Other research findings provide evidence of convergence of the two banking models serving as evidence of diminishing differences in terms of their operations and business models. Johnes et al. (2014) find that Islamic institutions are typically on a par with conventional banks in terms of gross efficiency with high net efficiency attributed to their high managerial capability. Beck et al. (2013) argue that the functioning and organization of Islamic banks is indeed less different from that of

conventional banks than often proliferated. Doumpos et al. (2017) support this by using a multicriteria methodology which captures different performance variables such as capital strength, asset quality, earnings, liquidity, and management quality in controlling expenses. Their findings suggest that the overall financial efficiency difference between Islamic and conventional banks is statistically insignificant. Furthermore, the same study reveals that second stage regressions show that the bank overall financial strength index is influenced by various country-specific attributes. These include control of corruption, government effectiveness, and operating controls that are expected to drive the next big wave in Islamic finance. Johnes et al. (2018) argue that efficiency and the speed of convergence between Islamic and conventional banks are similar. Bouchaddakh and Ben Jemaa, (2016) assess the degree of technological (in)efficiencies in the MENA region, between the two groups of banks and find no significant differences. Wanke et al. (2019) in their study of banks in the MENA region support that bank type, origin, and ownership impact efficiency levels differently in terms of profit sheet, balance sheet, and financial health indicators. They importantly note however, that the impact of culture and regulatory barriers seem to prevail at the country level only, in agreement with Doumpos et al. (2017).

In another important dimension, there is also the emergence of some studies that cross examine efficiency and competition in relation to financial stability specifically for the MENA/G.C.C region. Such policy studies span the period both before and after the crisis, most notably the decade 2005 – 2015. Trad et al. (2017) find that after the international financial crisis of 2008, many conventional banks have experienced crises in contrast to Islamic banks which remain more stable and more profitable. Chaffai (2019), compares banking performance and resiliency between Islamic banks and conventional banks in MENA region over the period 2002–2014. The study finds evidence of the bank type affecting technical efficiency as well as some evidence of bank size influencing efficiency levels. The research also finds that conventional banks are much more vulnerable to an important drop on their lending activities than non-lending activities, while Islamic banks are equally vulnerable to any drop of the activity. Their findings suggest that (i) very large banks are much more resilient than small banks whatever is the bank stream and (ii) diversification for Islamic banks is a major source of revenues. Albaity et al. (2019), investigate the impact of competition on bank stability across eighteen MENA countries between 2006–2015. They suggest that banks facing little competition tend to take less insolvency and credit risks and enjoy more profitability. The authors find that the competition-fragility effect is more prominent for Islamic banks than conventional ones in MENA countries.

Overall, the research so far shows that on the one hand, there is a certain degree of plurality in conclusions in the Islamic/conventional bank efficiency and competition debate. On the other, some research also points to convergence among business models and risk taking but a differential effect on banking stability. Regarding the pre-crisis period, scholars have commented that despite the largely consistent Islamic asset growth, many prudential establishments and regulators, as well as finance practitioners remained largely unaccustomed to the process by which Islamic banking has been introduced and co-exists with a conventional system (Sole, 2007). The literature points to the fact that due to the increasing financial integration between the MENA and other countries, the efficiency of banks must be analysed further considering the increased economic interdependence and the context of liberalization and internationalization. The empirical results from post-crisis studies, suggest that average profit efficiency and stability varies across banks and across MENA countries. One of the main questions that may also warrant further investigation is the large technological gap ratios that also seem partly responsible for divergence differentials which promote the existence of regional barriers in terms of differences of technology among banks in the MENA countries. Finally, post-crisis research also calls for international level comparisons that can shed more light on the underlying differences or similarities of bank efficiency among MENA countries in order to better adjust to the new post-crisis environment.

3. Methodology and data

Recent literature (Beck et al., 2013; Doumpos et al., 2017; Abid and Goaied, 2017), has discussed the superiority of efficiency frontier techniques compared to ratio-based techniques since they permit the estimation of performance by matching/following the best practice perceived as "benchmarking" (i.e. the long-term evaluation) as opposed to an absolute target (i.e. the short-term evaluation).

Efficiency scores afford an easy ranking and a transparent comparison of banks for each frontier and can explain differential performance. The most commonly used frontier specifications are the cost, revenue and profit. Non-parametric estimation techniques, such as DEA, are robust in estimating the 'true' cost and revenue frontiers and associated economic measures including data sets even without single output firms and are also less affected by distributional assumptions. (Parman and Featherstone, 2019). This method does not require the specification of a function, the imposition of curvature required for a cost function and it is not technologically restrictive. The cost, revenue and profit efficiency concepts provide separate valuable information that can trace the causes of inefficiency. An analysis in terms of cost efficiency establishes whether operational errors are on the side of the input alone. An analysis in terms of revenue ascertains whether operational errors are on the side of both inputs and outputs. An institution is considered as efficient in terms of cost if it minimizes costs by using the optimal level of inputs. However, the said institution can also be inefficient in terms of revenues if it produces very little or no optimal mix of outputs provided the inputs utilised and the competitive prices. For the purpose of the paper, we incorporate the suggestion of Mohl and Hagen (2010) who recommend the use of regional data that would allow for a more accurate analysis of efficiency and also for maximizing the discrimination existing between various DMUs (see section 3.1).

We follow established research that demonstrates that cost efficiency is a wider concept than technical efficiency, since it refers to both technical and allocative efficiency (Pasiouras et al., 2009). Cost efficiency measures how far a bank's cost is from its best practice cost (Isik and Hassan, 2002). Regarding output efficiency we examine the often-overlooked benchmark of revenue efficiency as a further contribution. Revenue efficiency is also a wider concept as it combines both costs and revenues in the measurement of efficiency. Our examination of this aspect is based on two main reasons: (i) one of the main roadblocks to profitability at a bank is compartmentalized models where product standardization for Islamic banking is fractured and hence income diversification is of the utmost importance and (ii) diversification benefits might be, partially at least offset, by the increased exposure to volatile non-interest related income activities (Doan et al., 2018), which is one of the main characteristics of sharia-compliant banking. We further argue that this type of efficiency is important for two reasons: first, banks attempt not only to offer a variety of products and services at the minimum attainable cost only but also to maximize revenues. By neglecting the revenue aspect, a fractional and possibly ambiguous, assessment of bank performance is produced (Cuesta and Orea, 2002; Rezitis, 2008; Feng and Serletis, 2010). Secondly, recent research has also documented this type of distortion claiming that such (in)efficiencies may indeed be much more relevant than previously projected where for example profit inefficiencies have generally been found to be larger than those attributable to the failure to minimize costs (Fethi and Pasiouras, 2010; Lozano-Vivas and Pasiouras, 2010). Banks can generate higher revenues by increasing costs, hence revenue efficiency can also lead to greater cost inefficiency hence our orientation considers the revenue output.

Sample and Data Collection

We use a balanced panel data set of 50 banks (25 Islamic banks and 25 conventional banks) with data collected from the banks' financial statements utilizing Thomson-One World Scope and DataStream. We require that all banks are simultaneously present in both databases. Our data period covers the post-crisis financial reporting years from 1st January 2010 to 1st January 2017. The data used in this study are cross-country, bank-level data, of 50 banks in 9 countries for each year. The nine countries that make up our data are: Saudi Arabia (KSA), Kuwait, United Arab Emirates (UAE), Oman, Jordan, Lebanon, Bahrain, Egypt and Qatar all with both types of banks operating in the region with Islamic

banks operating side-by-side to conventional banks. Table 1 gives the country-wise breakdown of both Islamic and conventional banks.

Insert Table 1 here

3.1 Data envelopment analysis

We apply the non-parametric Data Envelopment Analysis (DEA) as our method to evaluate the cost efficiency and revenue efficiency of Islamic versus conventional banks. This methodology is used to estimate cost and revenue efficiency scores of multiple decision-making units (DMUs) when the production process presents the structure of multiple outputs and inputs. It is not the purpose of this paper to juxtapose the use of the DEA technique against other methodologies. This technique is capable of dealing with multiple inputs and outputs and can be used with any input-output measurement. The sources of inefficiency can be quantified and analyzed for all units and there is no requirement to specify a mathematical form for the production function. After selecting variables such as unit cost and output, the DEA will search for the points with the minimum unit cost for any output; connecting those points will form the efficient frontier. A bank will be considered inefficient if it does not lie on the frontier. A bank is said to be more cost efficient if it can use fewer inputs to generate the same level of outputs as another bank. Thus, we can determine the cost efficiency by how close a bank's costs lie to the efficient frontier of a particular technology. A bank is said to be more revenue efficient if can produce more outputs with the same level of inputs as another bank. If a bank is using one input to produce only one output, then the easiest way to measure efficiency is:

$$\text{Efficiency} = \frac{\text{output}}{\text{input}}$$

If the bank is using various inputs to generate multiple outputs, then the relative efficiency can be measured using the following ratio:

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The input-oriented model attempts to test if a DMU can decrease its current input and still generate at least equal amounts of outputs. The output-oriented model attempts to test if a DMU can increase its current output using the same input levels. Following a standardized approach to inputs and outputs (Färe and Primont, 1995) we denote:

$\boldsymbol{x} = (x_1, \ldots, x_N) \in \mathbf{R}^N_+$ be the input quantities, with associated input prices $\boldsymbol{u} = (u_1, \ldots, u_N) \in \mathbf{R}^N_+$
$\boldsymbol{y} = (y_1, \ldots, y_M) \in \mathbf{R}^M_+$ be the output quantities, with associated output prices $\boldsymbol{v} = (v_1, \ldots, v_M) \in \mathbf{R}^M_+$

Accordingly, total costs and total revenues can be defined as:
$\boldsymbol{u}'\boldsymbol{x} = \sum^N_{n=1} u_n x_n$ and $\boldsymbol{v}'\boldsymbol{y} = \sum^M_{m=1} v_m y_m$, respectively.

Following García-Alcober et al. (2014) we note that we are assuming that both input and output quantities are divisible as well as the costs and revenues they generate are also divisible. As mentioned earlier, the DEA compares a DMU (Decision-making unit) to an objective on the frontier, which is the best practice frontier based upon the current data set. Our DMUs are denoted by $DMU_b,\ b = 1,\ldots,n$

Hence, inputs are denoted by $x_{ib},\ i = 1,\ldots,u$ where u is the number of inputs. x_{ib} is b^{th} DMUs, i^{th} input, where x_{43} is 3rd DMUs, 4th input.
Accordingly, outputs are denoted by $y_{ib},\ i = 1,\ldots,v$ where v is the number of outputs. y_{ib} is b^{th} DMUs, i^{th} output, where y_{35} is 5^{th} DMUs, 3rd output.

Following studies on banking efficiency we adopt the intermediation service approach (Miller and Noulas, 1996; Isik and Kabir, 2002b; Isik and Kabir, 2003a; Basu et al., 2011) where we model Islamic banks as multi-product firms, producing two outputs employing three inputs. Using input-oriented DEA, inputs and outputs of the banking industry are selected as follows:

- Inputs (i = 1, 2, 3; *u* = 3)
  - Fixed Capital, where the metric is total expenditure on fixed assets
  - Equity
  - Labor, where the price of labor is measured as total expenditures on employees: salaries, employee benefits and reserves for retirement pay
- Outputs (*i* = 1, 2; *v* = 2)
  - Income (major income, interest plus non-interest) and,
  - Other reported income

The input-oriented model for cost efficiency

This model seeks to reduce the current input by the same factor *E* with outputs been kept at their current levels. Where *E* is a decision variable that represents the cost efficiency of the bank under evaluation. Where λ_b is the weight that corresponds to each DMU_b and in the model each λ is set equal to 1. E^* represents the optimal solution with a value *not greater* than 1. The cost efficiency model is summarized as:

$$\boldsymbol{E^* = minE}$$

Subject to:

$$\sum_{b=1}^{n} \lambda_b x_{ib} \leq E x_i \qquad i = 1,....u$$

$$\sum_{b=1}^{n} \lambda_b y_{ib} \geq y_i \qquad i = 1,...,v$$

$$\sum_{b=1}^{n} \lambda_b = 1 \qquad b = 1,...,n$$

- If $E^* = 1$, then the current inputs levels cannot be decreased, showing that the DMU lies on the DEA frontier.
- If $E^* < 1$, then the bank is inefficient *(IE),* and the same level of outputs can be achieved using less inputs resources.

For example, an *E** = 0.824 = *IE* shows that the bank is inefficient as it has wasted 21.36% of its inputs or alternatively it could have saved 21.36% of its inputs to produce the same level of outputs[1].

The output-oriented model for revenue efficiency

The model seeks to increase the current output by the same factor *E* with inputs been kept at their current levels. As before, *E* is a decision variable and represents the revenue efficiency of the bank under evaluation. Where λ_b is the weight that corresponds to each DMU_b and in the model each λ will be set equal to 1. E^* is the optimal solution with a value of *not less* than 1. The revenue efficiency model summarized as:

$$E^* = maxE$$

[1] The relation between efficiency (*E*) and inefficiency (*IE*) is *IE* = (1-*E*) / *E*. Hence a cost efficiency of 0.824 for example, implies an inefficiency of 21.36%, not 17.6% (i.e. 1-0.824).

Subject to:

$$\sum_{b=1}^{n} \lambda_b x_{ib} \leq x_i \qquad i = 1,....u$$

$$\sum_{b=1}^{n} \lambda_b y_{ib} \geq E y_i \qquad i = 1,...,v$$

$$\sum_{b=1}^{n} \lambda_b = 1 \qquad b = 1,...,n$$

If $E^* = 1$, then the current outputs levels cannot be increased, showing that the DMU lies on the DEA frontier.
If $E^* > 1$, then the bank is inefficient *(IE)* and the same level of inputs can be used to achieve more outputs. An *E** = 1.31 = *IE* shows that the bank is inefficient *(IE)* as it generates approximately only 76.3% of the revenues that it could be expected to produce. Alternatively, there is an opportunity foregone in order to generate 23.7% more revenue giving the same amount of inputs.

3.2 Association among variables

We follow relevant research (Matthews et al., 2007) where we associate our inputs and outputs with the two levels of efficiency discussed above. As discussed above, pure cost-efficiency models can potentially distort the type and the magnitude of inefficiency in banks. That is, banks for example can generate higher revenues by overspending alone. Thus, revenue efficiency might lead to cost inefficiency. The model(s) we investigate is specified as follows:

$Eff. = \alpha_0 + \beta_1 FC_{i,t} + \beta_2 E_{i,t} + \beta_3 L_{i,t} + \beta_4 I_{i,t} + \beta_5 OIi_{,t} + \beta D_{\text{bank-type}} + \varepsilon_{i,t}$, where:

Eff.; is the cost and/or revenue efficiency, FC; denotes the Fixed Capital, E; Equity Capital L; Labor costs, I; Income, OI; Other Income, $D_{\text{-bank-type}}$: dummy variable bank type that takes a value of 0 for Islamic banks, 1 otherwise, ε; error term, and i, t; bank i at time t

4. Data Analysis and Results

4.1 Descriptive Statistics

The descriptive statistics for input and output variables for the two subsamples (IB and CB) are provided in Table 2 below are reported rounded and in millions of US dollar values.

Insert table 2 here

We report the descriptive statistics for the two sets of banks as well as the corresponding statistics for the pooled sample of 50 banks. The mean, median, standard deviation of all input and output variables show considerable variation in the sample drawn from 9 different countries with varying economy sizes. This first set of data shows that conventional Banks appear to be on average much bigger banks by fixed capital with higher equity capital injected in the firm. They also appear to have higher total average income, where this income also includes income from other sources. Conventional banks also seem to incur higher labor costs. The panel's year-wise corresponding statistics as well as the yearly growth rates for all variables provide for a clearer demonstration of data dynamics and differences in Table 3 below.

Insert Table 3 here

The growth rates in inputs/outputs overall seem to be higher for Islamic banks on average compared to conventional banks apart from other income sources. At the same time, while conventional banks seem to have higher labour costs they also seem to control the growth in such costs more efficiently than their Islamic competitors. Such growth in costs is approximately half. This is an aspect that potentially has important implications in terms of cost efficiency as it will be discussed below. Contrary to this, Islamic banks have a much higher income growth rate regarding income generated from their main operations.

4.2 Cost efficiency results

Starting with Islamic banks at the top half of Table 4, the overall mean cost efficiency stands at 0.81 (inefficiency of 23.11%) with an overall standard deviation of 20.34%. The minimum cost efficiency value observed is 0.244 for this set of banks. There results contrast sharply with the overall statistics for the conventional banking industry. The overall cost efficiency for conventional banks is 0.905 (inefficiency of 10.5%) with no mean cost efficiency score in any given year being below 0.83. Hence, *the* maximum inefficiency observed in year 2016 is 20.48%, and this is lower than the overall mean inefficiency index of Islamic banks. The minimum value observed does not fall below 0.60. For the same set of banks, we report an overall average standard deviation of 12% throughout the years. For conventional banks, the results show large consistency throughout the years in terms of their mean cost efficiencies and standard deviation compared to their Islamic counterparts.

Insert Table 4 here

Overall, the results indicate that conventional banks are consistently more cost efficient (except for 2016 where Islamic banks are marginally, 2.3% more efficient). The table also indicates the higher average cost efficiency of conventional banks over the whole period indicating a lower waste of inputs. In contrast, the cost efficiency of Islamic banks stands at 0.81 and seems to decline with the end of the crisis period (2009–2010). This coincides with increasing fixed capital expansion, increasing labor costs and importantly, the lagged price adjustments and the value decline of the real estate markets of many Middle Eastern countries following the global financial crisis. This may also partly be owed to real estate exposure and diversification issues on the part of Islamic banks as a large number of their contracts were backed by profit-sharing real estate and property serving as collateral. The results seem to also agree with earlier literature arguing that the middle of the crisis was more problematic for conventional banks due to lower liquidity reserves and lower equity buffers. In line also with topical literature, it seems that conventional banks can improve their efficiency, are quicker to adapt and redeploy their portfolios following the regulatory strengthening of capital restrictions and official supervisory powers (Chortareas et al., 2012).

4.3 Revenue efficiency results

Table 5 below, presents the revenue efficiency calculated relative to separate frontiers for both bank types. Like the cost efficiency scores, the results indicate that conventional banks are more revenue efficient for the period 2010-2017 (the exception is once again year 2016) with an average revenue efficiency score of 0.893 approximately. Islamic banks seem to lag as well compared to their counterparts in that they can generate approximately only 81% of what they could have produced over the same period suggesting that they are 23.45% revenue inefficient on average, which is approximately double the conventional banking inefficiency. The results also show that there was a decline in revenue efficiency for conventional banks in the years 2015, 2016 and 2017 from its prior level but overall, they are more revenue efficient compared to Islamic banks.

Insert Table 5 here

The efficiency score results as presented above, demonstrate that Islamic banks are on average both less cost and revenue efficient than their conventional counterparts throughout the whole post-crisis period. Conventional banks operate much closer to their efficient frontier compared to the other set of banks in our sample. It may also be the case that a major source of managerial inefficiency for Islamic banks is the inability to control labor costs since the data shows a nearly one-for-one increase between sales revenue (total income) and labor costs. These and other aspects are examined in the section below.

4.4 Correlations and Regression Results

The average cost and revenue efficiency for the whole sample of banks in the region is 85.8% and 85.3% respectively as shown in table 6 below.

Insert Tabe 6 here

We correlate our variables with the two types of efficiency controlling for bank type in table 7. The two types of efficiency are highly positively correlated with one another (0.910); Total Income (Income + Other Income) seem to be highly associated with both types of efficiency across the sample and they display the expected signs (i.e positive). Fixed capital, is significantly negatively associated with both revenue and cost efficiency. Equity and labour are significantly negatively associated with revenue efficiency.

Insert Table 7 here

Determinants of DEA Efficiency Measures in Islamic Banks

In order to determine the extent to which our factors, affect efficiency scores, we examine these aspects of the banks' structure as related to efficiency estimates. The generally accepted methodology proceeds in two stages. The first is to analyse the efficiency measures for each bank. The second stage is to regress the resultant efficiency scores on a set of explanatory variables that explain the efficiency scores. The efficiency scores are regressed on a set of common explanatory variables. Our procedure is further elaborated as follows: (i) we perform the regressions on the whole set of banks, (ii) then we perform the regressions for both types of efficiency in each set of banks.

Starting with tables 8 below, we run our test for the pooled sample. Bank type is a significant determinant of efficiency across the sample. Both types of Income are a significant factor affecting both efficiency scores. Equity has a significantly stronger negative effect on cost efficiency, and is significant but not as strong in explaining revenue efficiency. Fixed capital does not seem to be an influential factor. There is also a negative effect (5% significance level) that labour costs have on both revenue and cost efficiency overall. The fact that FC is not associated with any type of efficiency and at the same time labor costs are weakly associated with both types of efficiency may also suggest an alternative explanation possibility related to scale efficiency; there are limited benefits to increasing the size of operations. Potentially the absence of precise Islamic banking regulations stops these banks from the optimum utilisation of capital and labour and other inputs as well as the capacity to operate at the optimum proportions (Kabir, 2006). This is also possibly an explanation as to why banks commit to do their businesses purely along the lines of Islamic Shariah, purely through conventional norms or through an Islamic banking window alone. Next, we move on to decompose this analysis into each type of bank in the region.

Insert Table 8 here

Next we examine cost and revenue efficiency separately on each type of bank. Research has pointed out that in banking, output markets may not be perfectly competitive, as well as output prices are not accurately measured or indeed available for all sizes of banks (Isik and Kabir, 2003a; Chortareas et al., 2012). Bank-type constraints banks may not be able to achieve every output scale and product mix

(Berger and Humphrey, 1997; Kabir, 2006). Tables 9 and 10 report the efficiency model summaries for conventional banks.

Insert Table 9 here

For conventional banks equity seems a major aspect, negatively affecting cost efficiency whereas other income is significant and positively affects its cost efficiency. The latter result seems to agree with the current state of affairs in that investment and financing options available to Islamic banks are more limited in comparison to conventional banks (Hanif, 2014). As noted earlier, Islamic institutions cannot lend any amount in cash for interest, consequently certain financial needs of some sections of the market are ignored in financing for example personal loans and working capital requirements of not for profit organizations. This is also our observation – with regards to income - throughout the rest of the analysis findings following.

Insert Table 10 here

Revenue efficiency is significantly and positively affected purely by the income generating capacity of the banks. The effect of the linkages between the financial and real sector regarding Islamic banks have very well been documented (Darrat et al., 2003; Creane et al., 2004; Srairi, 2010; Chapra, 2011). Islamic institutions cannot create liquidity and extend credit facility without having support from the real sector based on the profit/loss sharing principle of doing business. For such institutions, the avenues for creating the optimal required liquidity are more limited and at the same time are constrained from earning some revenue by investing in short term and liquid securities such as money at call and short notice. This re-iterates the competitive advantage that conventional banks' income structures have over such institutions. The next set of tables (tables 11 and 12) presents the analysis regarding Islamic banking efficiency and the associated analysis.

Insert Table 11 here

Insert Table 12 here

As can be seen from tables 11 and 12 above, equity and labor are both aspects that exert significant (negative) influence on both cost and revenue efficiency. The descriptive statistics earlier and our findings show that Islamic banks have on average lower equity positions than commercial banks of similar size. However, recent stability–size relationship studies suggest that Islamic banks should expand their size and equity base, as they can be more stable when stringent regulations, monitoring, and supervision are adhered to. Major income is an aspect that contributes significantly and positively to efficiency. Regarding the latter, scholars have pointed out that while during the recent financial crisis both types of banks were affected, the measure of impact was not the same; partially, the inability of alternative income generation affected the liquidity, risk, and capital of Islamic institutions to deal effectively with the aftermath of the crisis (Mahdi et al., 2018). The profitability, capitalization, and liquidity of Islamic banks outperformed that of conventional banks in the earlier period of the financial crisis; it became significantly worse at the later stage because of the economic downturn. This is because the depositor and shareholder structure of Islamic banks constitutes a higher share of the industry ownership. Although Sharia-compliant restrictions condense Islamic banks' risk appetite, authors have argued that liquidity and insolvency risk are influenced by the income sources and income structure of Islamic banks (Beck et al., 2013).

5. Conclusions and suggestions for further research

An important finding of our research is that some results contrast with prior research in terms of the pre/post crisis performance between Islamic and conventional banks. Some pre-crisis research shows that domestic Islamic banks had consistently outperformed foreign banks during the crisis in terms of profitability and efficiency (Turk-Ariss, 2009; Berger and DeYoung, 2013; Bourkhis and Sami Nab,

2013). Conventional banks on the other hand, had elevated risk exposures owed to the higher number of subsidiaries in the developed economies. The results of our research support the view that conventional banks are both more cost and revenue efficient than Islamic banks over the period under examination. We find that Islamic banks underperform their conventional counterparts on both accounts. When we measure efficiency by employing the Data Envelopment Analysis (DEA) technique our analysis reveals that the bank efficiency index is influenced by bank-type attributes. So far research supports that at the bank level, the alignment in the two banking systems is associated with the major aspects of cost structures, income diversification, liquidity, and financial stability. At the same time, there is also a great deal of heterogeneity among Islamic banks in the samples that have been examined here and by other researchers. For example, countries like Sudan and Malaysia are polar opposites, while GCC countries can be found in the middle of the Islamic banking spectrum. Hence, the constructed efficiency scores should be interpreted cautiously as divergent Islamic banks are pooled in the same samples. In the aftermath of the crisis, Islamic institutions have been mostly labeled cost/profit/revenue inefficient. It also seems that tighter restrictions on bank activities are negatively associated with bank efficiency. Future weaker profitability could entail further cost-cutting (i.e. more efficient delivery of services), diversification into new revenue sources or even the adoption of riskier business profiles; yet, if weak profitability is a sign of overcapacity, exit from specific markets or services is an integral component of structural adjustment in the sector.

In other aspects, such as managerial risk management efficiency Islamic banks have also been found to be inferior. The implication of this is that developing and maintaining managerial skill is an indispensable instrument for the long-term endurance and competitiveness of any system. A related feature is thus, an effort to determine the holistic efficiency (including managerial) of Islamic banks as a guide for policy-makers to improve managerial performance and investors and clients to make informed choices. For example, in countries with diminished managerial efficiencies the main concern of the system should be on improving the managerial and risk capabilities of banks. More important than using more inputs, is to establish what the appropriate inputs are, the quality level required and how they can be brought together.

Supervising authorities in dual banking systems and countries can endorse such reforms that enhance sophisticated competition in their topical banking markets. This would allow domestic banks (Islamic) to expand their loan portfolios, to open the avenues for new income structures (diversification) and to provide more innovative products, which would increase their market shares, provide for effective diversification and improve their performance and balance out market power. A further implication is that studies so far have been largely designed and implemented with a view to screening and analyzing institutional performance only. As such, they do not adequately consider important social facets and cross-border investor interactions. Although it is imperative to investigate the strength of Islamic financial institutions and their close competitors it is equally important to investigate the growing correlations between competing systems. As economies and banking markets become increasingly intertwined it would be very interesting to examine how Islamic and conventional banks synchronize through the economic cycles. Linked to the above, research has also shown that the market power of Islamic and conventional banks is different within regions; dual, synchronous banking systems can have potentially important regulatory implications in terms of the competitive environment, price setting, financial stability, and profitability.

From a prudential policy dimension, more research and more comparisons at an intercontinental level are required since topical variations can potentially shed light on the nature of policy interventions required in order to strengthen the competitive functioning of the regional banking markets. For example, the reduction of technological gaps by cross-country/cross-market collaboration, the reduction of entry barriers and investment in technological innovations (for example making Fintechs esoteric to the system), can enable regional competitive blocks to undertake global strategic decisions, to benchmark their banking performance to their global counterparts, and to prepare for increasing competition in both topical and cross-border markets.

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List of Tables

Table 1: Final Sample List of Islamic and Conventional banks

Islamic bank	Conventional bank
Dubai Islamic Bank (UAE)	Byblos Bank S.A.L (Lebanon)
Abu Dhabi Islamic Bank (UAE)	Bank of Sharjah P.J.S.C
Abu Dhabi Islamic Bank Egypt SAE (Egypt)	Commercial Bank of Kuwait K.P.S.C
Sharjah Islamic Bank (UAE)	The Saudi British Bank SJSC
Ajman Bank (UAE)	Emirates NBD Bank (P.J.S.C)
Bahrain Islamic Bank	Commercial Bank of Dubai PSC
Emirates Islamic Bank	Abu Dhabi Commercial Bank
Riyadh Bank (KSA)	Burgan Bank S.A.K.P (Kuwait)
Kuwait International Bank KSC	Ahli united Bank K.S.C.P (Kuwait)
Qatar international Islamic Bank QSC	Bank Audi SAL (Lebanon)
Qatar Islamic Bank	National Bank of Oman SAOG (Muscat)
Qatar First Bank	Al Ahli Bank of Kuwait
Al Salam Bank-Bahrain B.S.C	Banque Saudi Fransi SJSC (Riyadh)
Union National Bank (UAE)	The Saudi investment Bank SJSC
Bank Aljazira (KSA)	Bank Muscat (SAOG)
Jordan Islamic Bank CO.PLC	HSBC Bank Oman S.A.O.G
Masraf AL Rayan (Q.P.S.C) (Qatar)	Arab Bank PLC (Jordan)
AL Baraka Bank Egypt SAE	Blom Bank S.A.L (Lebanon)
Alizz Islamic Bank (Muscat)	Bank of Beirut S.A.L
Ithmaar bank BSC (Bahrain)	Bank Sohar S.A.O.G (Oman)
Alinma bank (KSA)	Bank Dhofar S.A.O.G (Oman)
Bank Albilad (KSA)	Gulf Bank K.S.C.P (Kuwait)
Bank Nizwa SAOG (Muscat)	Commercial Bank International PSC (UAE)
Boubyan Bank K.S.C.P (Kuwait)	National Bank of Fujairah (UAE)
Al Rajhi Bank (KSA)	Natinal Bank of Umm AL-Qaiwan (PSC)

Table 2: Descriptive Statistics of inputs and outputs (in millions of U.S. dollars)

Islamic Banks	*Fixed Capital*	*Equity*	*Labour*	*Income*	*Other Income*
Mean	14,360	1,970	240	510	260
Median	7,760	1,130	120	260	90
Standard Deviation	17,760	2,600	290	600	430
Range	74,360	10,190	1,310	2,710	1,980
Conventional Banks	*Fixed Capital*	*Equity*	*Labour*	*Income*	*Other Income*
Mean	24,020	2,810	330	860	360
Median	14,800	1,900	200	600	200
Standard Deviation	22,340	2,630	330	780	380
Range	95,200	9,600	1,400	3,200	1,200
Pooled Sample	*Fixed Capital*	*Equity*	*Labour*	*Income*	*Other Income*
Mean	19,004	2,393	301	709	310
Median	12,100	1,330	200	410	180
Standard Deviation	20,724	2,687	346	744	400
Range	98,540	10,190	1,400	3,300	1,980

Table 3. Year-Wise Descriptive Input-Output Statistics (in millions of U.S dollars)

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	*g%*
				Panel A: Islamic Banks					
Fixed Capital Mean	10,278	11,317	13,073	14,359	16,112	17,614	18,748	20,013	**9.99%**
Fixed Assets St. Deviation	13,136	14,565	16,717	17,758	19,203	20,202	21,105	22,239	
Equity Mean	1,630	1,765	1,868	1,974	2,144	2,273	2,422	2,610	**6.96%**
Equity St. Deviation	2,130	2,295	2,467	2,596	2,780	2,997	3,142	3,464	
Labor Mean	179.60	203.60	218.80	240.00	272.80	302.80	320.40	335.60	**9.34%**
Labor St. Deviation	220.44	233.65	237.86	291.95	324.69	340.83	363.12	384.99	
Income Mean	427.60	454.80	494.40	512.00	553.60	613.20	676.00	757.20	**8.50%**
Income St. Deviation	562.72	566.36	576.74	596.02	610.67	636.22	696.04	796.43	
Other Income Mean	199.20	222.80	249.20	260.00	289.60	542.80	297.60	368.00	**9.16%**
Other Income St. Deviation	378.85	409.71	435.77	429.10	422.37	1,216.75	440.68	532.02	
				Panel B: Conventional Banks					
Fixed Capital Mean	17,852	18,776	20,260	22,264	24,020	25,408	26,552	27,420	**6.32%**
Fixed Assets St. Deviation	18,051	18,297	19,300	20,904	22,342	24,347	26,580	27,337	
Equity Mean	2,084	2,248	2,464	2,568	2,812	2,928	3,144	3,356	**7.04%**
Equity St. Deviation	2,047	2,179	2,306	2,384	2,632	2,814	3,036	3,323	
Labor Mean	276.00	280.00	284.00	424.00	332.00	356.00	396.00	396.00	**5.29%**
Labor St. Deviation	253.77	259.81	259.29	667.26	332.57	346.51	384.58	380.22	
Income Mean	744.00	736.00	708.00	804.00	856.00	900.00	1,012.00	1.104.00	**5.80%**
Income St. Deviation	746.70	721.04	707.06	724.27	776.25	851.96	953.64	1,017.55	
Other Income Mean	204.00	224.00	248.00	288.00	364.00	396.00	412.00	404.00	**10.25%**
Other Income St. Deviation	222.64	218.48	243.45	281.84	378.46	432.51	432.36	473.88	
				Panel C: Pooled Sample Banks					
Fixed Capital Mean	14,065	15,047	16,667	18,3116	20,066	21,511	22,650	23,717	**7.78%**
Fixed Assets St. Deviation	16,086	16,795	18,235	19,607	21,002	22,489	24,078	24,945	
Equity Mean	1,679	1,786	1,918	2,011	2,185	2,288	2,442	2,609	**6.46%**
Equity St. Deviation	2,050	2,164	2,303	2,383	2,569	2,710	2,847	3,100	
Labor Mean	227.80	241.80	251.40	332.00	302.40	329.40	358.20	365.80	**7.04%**
Labor St. Deviation	240.24	247.57	248.45	518.13	326.65	341.21	372.13	379.91	
Income Mean	585.80	595.40	601.20	658.00	704.80	756.60	844.00	930.60	**6.85%**
Income St. Deviation	673.59	657.21	647.63	672.81	707.89	758.12	843.52	921.14	
Other Income Mean	201.60	223.40	248.60	274.00	326.80	469.40	354.80	386.00	**9.68%**
Other Income St. Deviation	307.54	324.96	349.34	359.57	398.68	906.78	435.91	498.96	

Table 4: Mean Cost Efficiency scores

Cost Efficiency IB vs CB		2010	2011	2012	2013	2014	2015	2016	2017
Islamic	N	25	25	25	25	25	25	25	25
	Mean	0.788	0.806	0.796	0.812	0.837	0.777	0.854	0.828
	St. Deviation	0.238	0.214	0.201	0.193	0.172	0.212	0.194	0.203
	Max	1	1	1	1	1	1	1	1
	Min	0.244	0.369	0.401	0.426	0.489	0.327	0.375	0.387
Conventional	N	25	25	25	25	25	25	25	25
	Mean	0.915	0.912	0.932	0.922	0.919	0.922	0.835	0.881
	St. Deviation	0.113	0.120	0.116	0.115	0.116	0.128	0.123	0.133
	Max	1	1	1	1	1	1	1	1
	Min	0.688	0.682	0.601	0.603	0.648	0.6	0.624	0.628

Table 5: Mean Revenue Efficiency scores

Revenue Efficiency IB vs CB		2010	2011	2012	2013	2014	2015	2016	2017
Islamic	N	25	25	25	25	25	25	25	25
	Mean	0.782	0.804	0.782	0.813	0.828	0.775	0.874	0.846
	Standard Deviation	0.237	0.205	0.207	0.189	0.181	0.209	0.159	0.183
	Max	1	1	1	1	1	1	1	1
	Min	0.331	0.439	0.401	0.435	0.444	0.46	0.527	0.426
Conventional	N	25	25	25	25	25	25	25	25
	Mean	0.910	0.913	0.925	0.907	0.900	0.887	0.831	0.871
	Standard Deviation	0.112	0.118	0.121	0.126	0.152	0.166	0.126	0.137
	Max	1	1	1	1	1	1	1	1
	Min	0.638	0.686	0.577	0.598	0.4	0.415	0.597	0.619

Table 6. Pooled Sample Regression Descriptive Statistics (in millions of U.S dollars)

	Mean	Std. Deviation	N
Cost Eff.	0.85845	0.176260	400
Rev. Eff.	0.85305	0.176070	400
Fixed Capital	19,004	20.724276	400
Equity	2,393	2.687447	400
Labor	301	0.346227	400
Income	709	0.744039	400
Other Income	310	0.486927	400

Table 7. Pooled Sample Correlations

Control Variable			Cost Eff.	Rev. Eff.	FC	Equity	Labor	Income	Other Income
Bank Type	Cost Eff.	Correlation	1.000	0.910***	-0.131***	0.056	0.084	0.197***	0.222***
		Significance (2-tailed)		**0.000**	**0.009**	-0.262	-0.094	**0.000**	**0.000**
		df	0	397	397	397	397	397	397
	Rev. Eff.	Correlation	0.910***	1.000	-0.207***	-0.136***	-0.148***	0.270***	0.267***
		Significance (2-tailed)	**0.000**		**0.000**	**0.006**	**0.003**	**0.000**	**0.000**
		df	397	0	397	397	397	397	397

***Correlation is significant at the 0.01 level (2-tailed)

Table 8. Multivariate Regression Test Results

Dependent Variable		B	Std. Error	t	Sig.
Cost Eff.	Intercept	0.718	0.019	37.868	0.000
	FC	-0.003	0.002	-1.202	0.230
	Equity	-0.027	0.010	-2.835***	**0.005**
	Labor	-0.090	0.045	-1.996**	**0.047**
	Income	0.196	0.042	4.624***	**0.000**
	Other Income	0.080	0.023	3.490***	**0.001**
	Bank Type	0.099	0.017	5.969***	**0.000**
Rev. Eff.	Intercept	0.717	0.019	37.705	0.000
	FC	-0.003	0.002	-1.434	0.152
	Equity	-0.019	0.010	-1.972**	**0.049**
	Labor	-0.099	0.045	-2.190**	**0.029**
	Income	0.208	0.042	4.892***	**0.000**
	Other Income	0.073	0.023	3.206***	**0.001**
	Bank Type	0.079	0.017	4.720***	**0.000**

***Significant at the 0.01 level
** Significant at the 0.05 level
* Significant at the 0.10 level

Table 9. Conventional Banks Cost Efficiency

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	99.0% Confidence Interval for B Lower Bound	99.0% Confidence Interval for B Upper Bound
1	(Constant)	0.864	0.022		38.743	0.000	0.806	0.922
	FC	0.000	0.002	-0.076	-0.197	0.844	-0.006	0.005
	Equity	-0.034	0.011	-0.712	-3.109***	**0.002**	-0.062	-0.006
	Labor	-0.047	0.037	-0.142	-1.271	0.205	-0.142	0.049
	Income	0.063	0.037	0.414	1.6878	0.093	-0.034	0.161
	Other Income	0.204	0.055	0.578	3.690***	**0.000**	0.060	0.348

a. Dependent Variable: Cost Eff.

***Significant at the 0.01 level

** Significant at the 0.05 level

* Significant at the 0.10 level

Table 10. Conventional Banks Revenue Efficiency

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	99.0% Confidence Interval for B Lower Bound	99.0% Confidence Interval for B Upper Bound
1	(Constant)	0.813	0.024		33.596	0.000	0.750	0.876
	FC	-0.003	0.002	-0.451	-1.183	0.238	-0.009	0.003
	Equity	-0.019	0.012	-0.356	-1.570	0.118	-0.050	0.012
	Labor	-0.065	0.040	-0.181	-1.636	0.103	-0.169	0.038
	Income	0.108	0.041	0.644	2.653***	**0.009**	0.002	0.214
	Other Income	0.197	0.060	0.509	3.286***	**0.001**	0.041	0.353

a. Dependent Variable: Rev. Eff.

***Significant at the 0.01 level

** Significant at the 0.05 level

* Significant at the 0.10 level

Table 11. Islamic Banks Cost Efficiency Regressions – Model Summary

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			99.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	0.677	0.023		29.256	0.000	0.617	0.737
	FC	-0.009	0.004	-0.833	-2.154	0.032	-0.021	0.002
	Equity	-0.042	0.015	-0.554	-2.780***	**0.006**	-0.081	-0.003
	Labor	-0.354	0.122	-0.523	-2.903***	**0.004**	-0.670	-0.037
	Income	0.661	0.091	2.028	7.238***	**0.000**	0.423	0.899
	Other Income	0.022	0.027	0.065	0.838	0.403	-0.047	0.092

a. Dependent Variable: Cost Eff.

***Significant at the 0.01 level

** Significant at the 0.05 level

* Significant at the 0.10 level

Table 12. Islamic Banks Revenue Efficiency Regressions – Model Summary

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			99.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	0.687	0.023		30.377	0.000	0.628	0.746
	FC	-0.008	0.004	-0.742	-1.912	0.057	-0.019	0.003
	Equity	-0.038	0.015	-0.524	-2.619**	**0.010**	-0.077	0.000
	Labor	-0.317	0.119	-0.483	-2.668***	**0.008**	-0.627	-0.008
	Income	0.620	0.089	1.955	6.951***	**0.000**	0.388	0.852
	Other Income	0.016	0.026	0.046	0.599	0.550	-0.052	0.084

a. Dependent Variable: Rev. Eff.

***Significant at the 0.01 level

** Significant at the 0.05 level

* Significant at the 0.10 level