Efficiencies in Islamic banking: a bibliometric and theoretical review

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Abstract: This study takes an intensive review of literature on Islamic bank efficiencies highlighting regional efficiency trends, contributing factors and integrated framework. Bibliometric and content analysis have been used to analyse 99 articles published between 2002 and 2019 taken from ISI Web of Science and Scopus contributed by leading authors, journals and regulatory bodies. This study makes various contributions with respect to effects of choice of variables, changes in choice of variables, difference in applicability of laws of return in various global locations, size of the organisations, efficiencies during crisis, Shariah compliance cost, framework for analysing efficiency of an Islamic bank and supervisory effects. The conceptual framework identifies outcomes of value creation, performance improvement and minimisation of failures.

Keywords: DEA; Islamic banking; efficiency trends; financial crisis.

Biographical notes: Syed Alamdar Ali Shah is a PhD candidate in Islamic Economics at Universitas Airlangga Indonesia. He has professional banking experience of over 14 years along with academic experience of more than five years.

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1 Introduction

Over the period of last 20 years, operations of Islamic banking have been expanded the world over with Bahrain and Malaysia emerging as hubs. According to Dusuki and Abdullah (2007) Islamic banking is the demand of new customers rather than of Muslim community alone. Iqbal and Molyneux (2005) argue that banks exist in any economy because of four reasons namely:

'1 intermediation services

2 creation of a wide range of assets and liabilities

3 offering financial services

4 creation of incentives'.

However, existence of Islamic banks is primarily based on involvement of business risks.

Assets of global Islamic banking industry are expected to cross over 3 trillion USD till 2021. This expansion along with structural and regulatory transformations has enlarged the footprint and impact of Islamic banking industry manifold. Many countries have successfully removed underlying distortions in the growth of Islamic banks and have moved ahead in restructuring and reorganising. Since primary role of Islamic banking is to secure and channelise funds on Shariah basis, the efficiency was not their top priority in the beginning. The concept of financial analysis was mostly neglected and in a very few cases analysts and researchers used a few conventional financial ratios.

The growth of Islamic banking is not uniform across regions. Some countries and regions have taken lead over the others (Johnes et al., 2014). There also exist many variants depending upon financial, economic, social and most importantly on Shariah basis. In this process reduced sources of Shariah compliant funding also encourages Islamic banks to develop alternatives based on geographical needs. As the financial side of world economies has encountered many obstacles including the financial crisis 2007–2008, economies also grew simultaneously from social, financial, technological and technical point of view which also helped in the expansion of Islamic financial sector. This expansion in growth has been analysed by many researchers in various dimensions. For instance, Nejad et al. (2018) analyse success factors of a bank in the context of employee motivation and found welfare facilities as the most important factor that creates motivation in employees leading to success. Derbali and Jamel (2018) analyse insurance in Tunisia and found size, age and growth as the major success factors be it takaful or conventional insurance. Sharif et al. (2018) analyse currency stability in the post financial crisis 2008 scenario and observe that the impact on currencies is more profound than most of the sectors of the economy. Singh et al. (2019) analyse the impact of selected managerial factors such as, supplier relationship, people management and top management support, etc., on business performance.

In the light of above developments, it has become necessary to review performance of Islamic banks across the countries and regions. Developments in the realm of Islamic banking suggest that such reviews can be made from various perspectives (Hassan and Aliyu, 2018). However, we take a concise approach to review efficiency analysis over the

last two decades based on input output analysis only. Our objective is not to restate findings of previous Islamic research but also to enlighten and synthesise the paths and conclusions to develop conceptual framework of efficiency analysis. Keeping in view this background we set our research objective as under:

1.1   Objective of the research

The objective of this research is to take an intensive review of research literature on efficiency of Islamic banks and present landmarks achieved in terms of theoretical contributions, institutional developments, efficiencies and synergies achieved, and competitiveness developed to compete conventional banks in various regions around the globe. In doing so not all published work has been taken into account rather a criterion has been developed to include high impact research only. The focus is to provide an intrinsic review of literature to students, policy makers and researchers to enhance their understandings of contemporary dynamics of Islamic bank efficiencies for future research.

This objective shall be addressed by answering the following research questions:

1   What are the drivers and theoretical underpinnings of efficiency analysis in Islamic banks?

2   What are the global clusters in the researches of efficiency analysis?

3   What are the available future research directions?

Reviews of Islamic bank efficiencies are required because of growing complexity with the increase in business (Chapra, 2017). Recently, various concerns raised by scholars Chapra (2017), Hassan and Aliyu (2018) and global policy makers such as World Bank and Islamic Development Bank Group (2017); Shabsigh et al. (2017) about global trends towards debt financing and system performance after paradigm shift to debt-based finance also encourages initiation of efficiency analysis taking a global perspective over the period of expansion in Islamic banking.

Productivity and performance analysis considering input-output relationship has been the subject of various recent studies (Gidwani and Dangayach, 2017; Abdelalim et al., 2019; Granadillo et al., 2019). A major research stream that has emerged over the period of time for efficiency analysis of financial institutions is the use of DEA (Berger and Humphrey, 1997; Chen, 2002; Saljoughian et al., 2019). Efficiency of Islamic banks using DEA has been assessed in various studies, however, the ones taking global perspective are almost negligible (Sufian and Kamarudin, 2015; Wanke et al., 2016; Hassan and Aliyu, 2018). Having said that analysing the efficiency of expanding Islamic banking is important because it is now accepted by Muslims and non-Muslims worldwide (Kumru and Sarntisart, 2016).

This research addresses our objectives firstly by comparing global efficiencies of Islamic and conventional banks; secondly by taking a holistic view of regional efficiency trends and finally by identifying the factors that contribute to growth of Islamic banks over the period of time. This will be achieved by analysing literature on the basis of:

1 theoretical foundations of Islamic bank efficiencies

2 how efficiency is analysed

3 and the impact of various versions of efficiency analysis.

This focus will provide guidance for students, policy makers, researchers, monetary control authorities and academicians to comprehend Islamic banking efficiency dynamics and will resultantly guide on subsequent studies.

2 Methodology

We have utilised co-citation along with content analysis following the recommendations of recent bibliometric studies (Apriliyanti and Alon, 2017; Alon et al., 2018). Bibliometric analysis is a recent mechanism that utilises statistical tools to determine qualitative and quantitative developments in a research topic (Apriliyanti and Alon, 2017; Randhawa and Ahuja (2017). In other words it is an advanced form of meta-analysis that Fetscherin and Heinrich (2015) use to identify objectively linked research manuscripts published in reputed journals with analysis unit being citations (Alon et al., 2018; Zamore et al., 2018). Instead of simple publication counting it takes into account impact of the research, authors, journals and research topic development (Fetscherin and Heinrich, 2015). We have primarily utilised ISI Web of Science (SOS) and Scopus because these are leading bibliometric data bases (Falagas et al., 2008). These data bases are although different however, Falagas et al. (2008) stated that these are correlated. This is supplemented with research reports from various monetary authorities and leading authors since in the early ages Islamic banking was not a popular phenomenon.

A recent literature review by Hassan and Aliyu (2018) addresses the literature from 1987 to 2017 taking a holistic review of entire work done in the area of Islamic banking. Their focus is to identify overall research directions not addressing any specific research area. Their work provides theoretical developments and contributions from performance of Islamic banks. However, their work do not take focused account of any specific area. Addressing this gap of combining actual performance with theories we have conducted a thorough review of literature of the 99 carefully selected research papers, published since 2003 covering data from 1990 to 2016, on variables used, results derived, theories, country/region of the study and finally the conclusions drawn. Having established the criteria this research does not fully cover all types of efficiencies and trends on account of lack of literature, for instance social and psychological impact of Shariah compliance, although a little effort has been made in this regard.

Next section takes a tabular review of literature followed by a combined graphical analysis of regional efficiency trends and factors contributing to various efficiencies over the period of time. An overall analysis integrating various themes emerging from literature, graphical analysis and factoral analysis followed by conclusion concludes this research paper.

Table 1   Literature review

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
1	Hussein (2003)	1990–2000	SFA: Input prices cost of capital, cost of funds, cost of labour, investment in murabaha, investment in other modes of finance, off balance sheet transactions. TOBIT regression: Total assets, total deposits, government banks, private banks, Islamic finance/total assets, musharika/total assets, bank finance through other modes of finance, tradeoff between musharika and murabaha finance, non-financial activities, musharika/off balance sheet items, murabaha/off balance sheet, deposit mix.	Sudan	Stochastic Frontier analysis, TOBIT regression	Joint ownership banks operate more efficiently than government owned banks. Bank size and equity size, capital adequacy ratio negatively affect cost efficiency. Shariah compliant products and personnel expenses have positive impact on cost efficiency of Islamic banks.
2	Hassan (2003)	1994–2001	DEA: Inputs labour, fixed capital, customer and short-term funds, Input prices: staff expenses/customer and short-term funding, total expenditure on fixed assets/customer and short-term funds, total interest expenses/customer and short-term funds, Output: total loans, other earning assets, off balance sheet items. Regression: Efficiencies, size of the bank, market power, profitability.	Pakistan, Iran, Sudan	Data envelopment analysis, Malmquist productivity index, correlation analysis, regression analysis	Islamic banks are less efficient than their conventional counterparts. Efficiency scores are highly correlated with profitability measures showing effect of efficiency on profitability. Islamic banks have better allocative efficiency than technical efficiency due to highly supportive regulatory environment. Scale inefficiency is higher than pure technical efficiency which shows that Islamic banks are suffering more from product diversification and market penetration rather than staff abilities. Productivity variation in Islamic banks is due to technological variations and not due to staff abilities.
3	Yudistira (2004)	1997–2000	DEA: Inputs: staff costs, fixed assets, total deposits Outputs: Total loans, other income, liquid assets Regression: Capital to total assets, net income to total assets, log of assets, market share, geographical location, listed and no listed banks	Bahrain, Kuwait, Qatar, United Arab Emirates, Indonesia Malaysia, Algeria, Gambia, Sudan, Egypt, Jordan, Yemen	Data envelopment analysis, OLS	Conventional banks have better efficiencies than Islamic banks. Islamic banks have performed better during crisis than their conventional counterparts. Islamic banks have fewer economies to scale than conventional banks. Islamic banks in middle east are less efficient than banks in any part of the world. Support from the regulator has better influence than market share on efficiencies of the banks.
4	Shams and Molyneux (2004)	1995–2000	SFA: Price of inputs: Price of deposit, price of labour Outputs: total loans, other income Price of outputs: price of loans, price of other income Logit regression: Total cost, profits, price of deposit, price of labour, total loans, other income, price of loans, price of other income, total equity, total provisions. equity, return on assets, provision, foreign bank dummy, loan/assets, fixed assets, total assets, total assets/GDP	Qatar, UAE, Saudi Arabia, Kuwait, Bahrain, Oman	Stochastic Frontier analysis, logit regression	Cost inefficiency between the region is between 8% to 10% and profit inefficiency is between 30% to 32%. The risk and quality have negative impact on efficiency levels of banks.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
5	Hassan (2005)	1994–2001	DEA: Inputs: Labour, fixed capital, customer and short-term funds Input prices: Price of labour, price of capital, price of funds Outputs: Total loans, other earning assets, off balance sheet items Regression: Efficiencies, bank size, profitability, loan ratio	Algeria, Bahamas, Bahrain, Bangladesh, Brunei, Egypt, Gambia, Indonesia, Iran, Jordan, Kuwait, Lebanon, Malaysia, Mauritania, Qatar, Saudi Arabia, Sudan, Tunisia, United Arab Emirates, UK, Yemen	Data envelopment analysis, regression analysis, correlation	Islamic banking industry is less efficient than conventional banking. All efficiency scores are highly related with ROA and ROE which means profitability can be increased with efficiency scores. Cost efficiency in Islamic banks is lower than profit and revenue efficiency which means Islamic banks mostly focus on revenues at whatever costs. The allocative efficiency is also higher than technical efficiency which means Islamic banks have to look for new avenues to generate revenues and control costs. Scale efficiency is also higher than pure technical efficiency which means that Islamic banks need to focus output related activities as well. Larger bank size and profitability are positively related with efficiency which shows banks need to increase their scale through diversification. Also major source of efficiency in Islamic banks is adoption of new technologies rather than improving managerial qualities.
6	Hassan (2006)	1995–2001	DEA: Inputs: Labour, fixed capital, customers and short-term funding funds Price of inputs: Total expenditure on employees/customer and short-term funding, total expenditure on premises and fixed assets/customer and short-term funds, total non-interest expenses on deposits and non-deposit funds/customer and short-term funding Outputs: Total loans, other earning assets and off balance sheet items.	Global	Data envelopment analysis	Islamic banks were less efficient than their conventional counterparts. The efficiency of Islamic banks is related to return on assets and return on equity. The main cause of inefficiency of Islamic banks was allocative inefficiency. Islamic banks are more efficient in countries where the whole banking system is Islamic. Technological advancement increases productivity of Islamic Banks. Islamic banks need to introduce more products to survive in competition with Islamic banks.
7	Mokhtar et al. (2006)	1997–2003	DEA: Inputs: Total deposits, personnel expenses, other operating or overhead expenses Outputs: Total earning assets Input prices: Return paid to depositors/total deposits, personnel expenses/total assets, other overhead expenses/total assets	Malaysia	Data envelopment analysis, regression analysis	Average efficiency of Islamic banks is increasing but is still less than efficiency of conventional banks. Efficiency increases with the increase in size and age of the bank.
8	Omar et al. (2006)	2002–2004	DEA: Inputs: Total deposits, personnel expenses, capital expenditure, input prices, price of deposits, price of labour, price of capital expenditure Output: loans and advances, capital market investments, and money market investments	Malaysia	Malmquist productivity index, data envelopment analysis	Total factor productivity increases with technical efficiency. Islamic banks are less efficient than conventional banks. Islamic bank efficiency increases are solely coming from increases in scale efficiency.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
9	Brown and Skully (2006)	2005	DEA: Inputs: Personnel expenses, non-interest expenses Outputs: Loan deposits, other earning assets Ratio analysis; assets, ROA, ROE, cost to income ratio, Islamic operations/total assets, equity investments/total assets, income from Islamic transactions/total assets, deposit and short-term funding/total assets, other non-interest bearing assets/total assets, equity/total assets, total funding, customer loans, total deposits, other earning assets, personnel expenses, non-interest expenses	Bahrain, Egypt, Iran, Jordan, Malaysia, Kuwait, Pakistan, Qatar, Russia, Sudan and United Arab Emirates	Data Envelopment Analysis, Financial Ratio Analysis	There exists no obvious relationship between, profitability, Islamic financing and efficiency. Islamic bank investments are short-term in nature but are more or ethical importance than financial investments. Islamic banks efficiency should be examined taking in view their social efficiency as well. As ethical performance takes time to grow therefore short-term poor results of Islamic banks should not be of concern.
10	Bader et al. (2007)	1990–2005	DEA: Inputs: Labour, fixed assets, total funds Outputs: total loans, other earning assets, off balance-sheet items, price of inputs and outputs: price of labour, price of fixed assets, price of funds, price of loans, price of other earning assets, price of off balance sheet items	Algeria, Egypt, Gambia, Senegal, Sudan, and Tunisia, Bangladesh, Brunei, Indonesia, Malaysia, and Pakistan, Bahrain, Iran, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Turkey, UAE, Yemen	Data Envelopment Analysis, Mann-Whitney test, Kruskal-Wallis test	Revenue efficiency is higher in all banks than their cost efficiency. New Islamic banks are more efficient than old Islamic banks.
11	Mokhtar et al. (2007)	1997–2003	DEA: Inputs: Total deposits, total overhead expenses Outputs: total earning assets, personnel and other expenses/total assets, return paid to depositors/total deposits	Malaysia	Data envelopment analysis	Efficiency of Islamic banks is increasing while efficiency of conventional banks is stable. Full-fledged Islamic banks are more efficient than window Islamic banks.
12	Sufian (2007)	2001–2005	DEA: Inputs: Total loans, total deposits Outputs: Investments, investments, loan loss provisions	Malaysia	Two model data envelopment analysis to account for sensitivity of efficiency scores, spearman and Pearson correlation	Foreign banks have higher efficiency than local banks, scale inefficiency is higher than technical efficiency. Technical efficiency is more effected by taking excessive risks. Scale efficiency has more effects on technical efficiency than pure technical efficiency. Islamic banks need to optimise their size because they are operating at decreasing returns to scale.
13	Sufian and Abdul Majid (2007)	2001–2005	DEA: Inputs: Total deposits, total assets, labour Outputs: Total loans, investments GMM: Natural log of deposits, loan/total assets, natural log of total assets, loan loss provision/total loans, net return income/total assets, equity/total assets, return on assets, natural log of gross domestic product, dummy of foreign banks. Dummy of Islamic banks.	Malaysia	Two stage: Data envelopment analysis, multivariate TOBIT regression analysis	Scale inefficiency in Islamic banks is higher than technical inefficiency. Banks are realising economies of scale. Foreign banks are more technical efficiency and consequently are more cost efficient.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
14	Hassan et al. (2009)	1990–2005	DEA: Inputs, Labour , fixed assets, total funds, price of inputs: price of labour, price of fixed assets, price of funds. Outputs: Total loans, other earning assets, off balance sheet items	Africa, Asia, Middle East	Data envelopment analysis, t-test, stochastic Frontier analysis	Profit efficiency is higher and stable than cost efficiency over the years, but the difference between Islamic banks and conventional banks is not significant. Islamic banks in middle east have higher cost efficiency than banks in other parts. Large size conventional banks have higher efficiencies than small banks
15	Mokhtar et al. (2008)	1997–2003	DEA: Inputs: Total deposits, total overhead expenses. Outputs: Total earning assets. Input prices: personnel and other expenses/total assets, return paid to depositers/total deposits	Malaysia	Data envelopment analysis	Efficiency of Islamic banks is increasing while efficiency of conventional banks is stable. Full-fledged Islamic banks are more efficient than window Islamic banks. Efficiency of Islamic banks was lower than conventional banks.
16	Kamaruddin et al. (2008)	1998–2004	DEA: Inputs: Personnel expenses, total deposits, fixed assets, input prices: price of labour, price of deposit, price of capital. Outputs: earning assets, other assets, other income	Malaysia	Data envelopment analysis	Efficiency of Islamic banks remains almost stagnant during the period. Cost efficiency of domestic banks was higher than foreign banks. Though domestic banks have better efficiencies but foreign banks are catching them up.
17	Sufian and Haron (2008)	2001–2005	DEA: Inputs: Total deposits, labour, total loans. Outputs: Investments	Malaysia	Malmquist productivity index, multivariate regression analysis	The productivity increase in Islamic banks is due to increase in technical efficiency but mainly from scale efficiency, without any support from technological advancement. Foreign Islamic banks are suffering from productivity regress due to technological and technical efficiency as well. Zakat paying Islamic banks are more efficient than non-zakat paying banks. Profitability and bank size has positive impact on bank productivity.
18	Sufian et al. (2008)	2001–2006	DEA: Inputs: Total loans, income, investments. Outputs: Deposits, assets	Bahrain Bangladesh Egypt, Gambia Indonesia Iran, Kuwait Malaysia Pakistan Saudi Arabia Turkey United Arab Emirates, Qatar South Africa Sudan Yemen	Data envelopment analysis	Banks in MENA region have better technical efficiency than Islamic banks in Asia. Also Islamic banks in countries with both Islamic and conventional banking systems display better efficiencies than countries solely with Islamic banking systems.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
19	Bader et al (2008)	1990–2005	DEA: Inputs: Total costs, revenues, profits Outputs: labour, fixed capital, total funds, total loans, other earning assets, off balance sheet assets, total personal expenses/by the total funds, depreciation expenses/the fixed assets, interest expenses on deposits and non-deposits funds plus other operating expenses/by the total Funds, Interest income/ total loans, other operating income/other earning assets, net commission revenue plus net earning income divided by off-balance sheet items	Egypt, Bahrain, Tunisia, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Turkey, UAE, and Yemen.	Data envelopment analysis	Cost and technical efficiency of all banks is better than revenue efficiency. No significant difference between efficiencies of Islamic and conventional banks. The behavior of Islamic and conventional banks is similar towards efficiency.
20	Sufian and Noor (2009)	2001–2006	DEA: Inputs: Deposits, capital, financing Outputs: Investments, income.	Asian countries and MENA region	Data envelopment analysis, correlation analysis, TOBIT regression analysis	Technical inefficiency in Islamic banks is higher than the scale inefficiency. Islamic banks in MENA region are more technically efficient than banks in Asia. Banks with low market share and low Non-performing loans have more technically efficiency. Banks with more technical efficiency have more profitability. Favourable economic conditions contribute to efficiency of the banks.
21	Johnes et al. (2009)	2004–2007	DEA: Inputs: Deposits and short-term funding, fixed assets |Outputs: General and administration expenses, equity Ratios: Cost to income ratio, non-interest expense to average assets, net interest margin, other operating income to average assets, return on average assets, return on average assets.	GCC countries	Data envelopment analysis, financial ratio analysis, Malmquist productivity index, correlation analysis	Islamic banks have less cost efficiency but more revenue efficiency. The results of Islamic and conventional banks are significantly different. Technical efficiency of conventional banks is higher than Islamic banks. In order to be more technically efficiency Islamic banks need to be more shariah compliant. Difference between efficiencies of Islamic banks also leads to difference between efficiencies of Islamic banks in different regions. Banks which are cost efficient tend to have better financial performance ratios. Although banks have improved on technical efficiency but their overall efficiency has decreased.
22	Hamilton et al. (2010)	1993–2006	DEA: Inputs: Total cost, net profit Input prices: Price of funds, price of labour, price of physical capital Outputs: Loans, investments, other earning assets, price of loans, price of investments, price of other earning assets.	Jordan	Stochastic Frontier analysis, data envelopment analysis	Profit and cost efficiency of Islamic banks is lower than the similar efficiencies of their conventional counterparts. Alternate profit efficiency which includes market power is higher in Islamic banks.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
23	Srairi (2010)	1999–2007	DEA: Inputs: Labour cost, fixed capital, total cost Outputs: Total profit, Input and output prices; personnel expenses/total assets, interest expenses/total deposits, other administration and operating expenses/fixed assets, net total loans, other earning assets, per capital GDP, M2 money supply/GDP, t total deposit of banking sector, average annual rate of inflation, density of population, assets of three largest banks/total assets of the country, total loans of banking sector/total deposits, total equity of banking sector/total assets, natural log of total assets, equity/total assets, net profits/average total assets, loans/total assets, cost/income	Bahrain, Kuwait, Oman, Qatar, Saudi Arab, UAE	Stochastic Frontier analysis, data envelopment analysis, maximum likelihood model	Banks need to put more control on personnel cost than on financial cost for improving technical efficiency. Countries with higher per capital income have lower cost efficiency. Countries with higher capital to asset, loan to deposit and population density have higher cost efficiency. Banks have significantly higher profit efficiency than cost efficiency. Higher demand of Islamic banking is leading to creation of monopoly of Islamic banks. The rise in bank efficiency is not systematic. conventional banks have better cost and profit efficiency than Islamic banks. Highly capitalised and profitable banks are less efficient.
24	Jreisat and Paul (2010)	1996–2007	DEA: Inputs: Labour, deposits, loans Outputs: Other investment	Jordan	Data envelopment analysis	Small size banks are more efficient than medium and large banks, domestic banks have better technical efficiency than foreign banks. The efficiency of Islamic banking sector is increasing overall.
25	Akhtar (2010)	2000–2006	DEA: Input: Interest expense, non-interest expense Output: Interest income, non-interest income.	Saudi Arabia	Data envelopment analysis, Malmquist productivity index	The productivity of Islamic banks is increasing due to adoption of new technology and not due to efficiency. Technical and pure technical efficiencies are decreasing.
26	Noor et al. (2010)	2001–2006	DEA: Inputs: Total deposits, assets Output: Total loans, income, investments	Bangladesh, Indonesia, Malaysia, Pakistan	Data envelopment analysis	Pure technical inefficiency in Islamic banks is higher than scale inefficiency. Banks in Indonesia are more efficient.
27	Ahmad et al. (2010)	2003–2009	DEA: Inputs: Total deposits, labour costs, Output: total assets, total loans, income, other earning assets	Bahrain, Bangladesh, Brunei, Egypt, Gambia, Indonesia, Iran, Iraq, Jordan, Kuwait, Malaysia, Mauritania, Pakistan, Palestine, Saudi Arabia, Singapore, Syria, Thailand, Turkey, UAE, UK, Qatar, Yemen, South Africa, Sudan	Data envelopment analysis	Islamic banks have higher pure technical efficiency than scale efficiency. In low income countries Islamic banks operate under increasing returns to scale. Banks that operate under increasing return to scale should endeavour to reduce their scale inefficiency.
28	Shahid et al. (2010)	2005–2009	DEA: Inputs: Deposit, Capital, Outputs: Investments, loans and advances, price of capital, price of deposits	Pakistan	Data envelopment analysis, t-test	Technical efficiencies of conventional banks are higher than Islamic banks while cost and scale efficiencies are lower.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
29	Onour and Abdalla (2010)	2007–2008	DEA: Inputs: Salaries and wages, deposits Outputs: Loans, net income	Sudan	Data envelopment analysis, Malmquist index	Bank ownership, and size have no relationship with efficiency of Islamic banks. Banks with improved technical efficiency also exhibit also depict productivity improvement.
30	Ahmad and Noor (2011)	1992–2009	DEA: Inputs: Total loans, total deposits, labour cost Output: Income, other earning asset, total assets. For Tobit multivariate analysis and fixed effect model: Operating expenses/total assets, equity/total assets, total loans and assets, loans/total assets, loans/deposit, and non-performing loans/total loans, while the loans/GDP, inflation, market capitalisation, and seven dummy to test various event (Asian financial crisis, global financial crisis ,Middle east and North Africa, low medium and high income countries) fall under economic condition.	25-Islamic countries	Data envelopment analysis, TOBIT model, fixed effects model, ordinary least square method	Islamic banks have greater technical efficiency. Banks in Asia with greater technical efficiency derive more profitable results.
31	Noor and Ahmad (2011)	1992–2009	DEA: Inputs: Total deposits, labour cost ,total assets Outputs: Total loans, income, other earning assets TOBIT and fixed effect model: total loans divided by total assets (LOANS/TA), log of total assets (LNTA), non-performing loans divided by total loans (NPL/TL), log of total deposits (LNDEPO), operating expenses divided by total assets (OE/TA) and book value of stockholders' equity as a fraction of total assets (EQUITY/ TOTAL ASSET). Logarithm of GDP, inflation, market capitalisation (MARKET), AFC, GFC, MENA, Asian countries, and country income level (LOW, MEDIUM and HIGH).	Global analysis	Data envelopment analysis, fixed effect model, TOBIT regression model	Islamic banks have better pure technical efficiency than scale efficiency. Pure technical inefficiency have lead to technical inefficiency. Technical efficiency is related with operating expenses, asset size, equity, non-performing loans, average fixed costs and GDP.
32	Mariani et al. (2011)	1996–2002	Labour expenses plus physical capital expenses and financial expenses, loan, other earning assets, price of labour, price of financial capital, price of physical capital, loan quality, equity/assets, Islamic bank dummy, merged bank dummy, financial crisis.Foreign bank with IB dummy, foreign bank without IB dummy, Domestic bank with IB dummy, publicly owned bank dummy.	Malaysia	Stochastic Frontier analysis, generalised Malmquist index	Islamic banks have lower cost efficiency than conventional banks. Asian crisis 1998 had negative affects on Malaysia banking industry. Banks with higher technical efficiency have higher productivity change as well. Technological advancement brings initial cost efficiency which then grows to cost efficiency with increase in productivity and technical efficiency. Merged banks did not have did not have any impact on their productivity. After mergers banks need to relaunch their products to reap benefits of mergers.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
33	Kablan and Yousfi (2011a)	2001–2008	DEA: Inputs: Labour, physical capital, deposits Outputs: Net loans, net liquid assets, total earning assets Price of inputs: Personnel expenses/total assets, other expenses/total assets, income	Algeria, Lebanon, Tunisia, Malaysia, Turkey, Yemen, Bahrain, Egypt, Jordan, Saudi Arab, UAE, Kuwait, Qatar, Iran, Pakistan, Sudan	Data efficiency analysis, stochastic frontier analysis, Haussmann test, correlation analysis	Size of the bank has negative impact on efficiency of the bank because of operating at wrong scale. Banks in Asia are the most efficient. Profitability and market power have positive impact on efficiency. It is more costly for Islamic banks to operate in country with Islamic government and Islamic systems.
34	Kablan and Yousfi (2011b)	2001–2008	DEA: Inputs: Labour, physical capital, deposits Input prices: Personnel expenses/total assets, other expenses/total assets Outputs: Income, net loans, net liquid assets, total earning assets. TOBIT regression: log of total assets, return on assets, bank deposit/total assets, deposits, urban population, GDP per capita, risk taking, dummy of Middle East bank, dummy of UK banks, dummy of Islamic banking system, dummy of subprime crisis.	Iran, Jordan, Kuwait, United Arab Emirates, Qatar, Bahrain, Lebanon, Saudi Arabia, Yemen, Pakistan, Malaysia, Turkey, Brunei, Sudan, Egypt, Tunisia, UK	Data efficiency analysis, stochastic frontier analysis, TOBIT regression model	Profitability and market power have negative impact on efficiency of Islamic banks. GDP has positive impact on efficiency while urban population has negative impact on efficiency of Islamic banks. Efficiency of Islamic banks in countries where solely Islamic banks exist is below average. Islamic banks depict higher efficiency in competitive systems. Islamic banks in countries which have better Islamic regulatory frameworks show better efficiency.
35	Hadad et al. (2011)	2003–2007	DEA: Inputs: Total consumer deposits and commercial borrowing, total employee expenses, total non-employee expenses Outputs: Total provisions, total commercial loans, other earning assets, net total off balance sheet income	Indonesia	Malmquist Index, semi-oriented radial measure-data envelopment analysis, truncated regression analysis	Major cause of productivity improvement is technological advancement. Risk Management efficiency also effects technical efficiency of financial institutions. Banks efficiency is highly related with stock market efficiency and log of total assets. The productivity of Indonesian banking sector is highly dispersed and volatile.
36	Tahir et al. (2011)	2003–2008	DEA: Inputs: Total deposits, overhead expenses Output: Total loans, other earning assets	Africa, Far East and Central Asia, Europe, Middle East	Data envelopment analysis	Islamic banks suffer higher from pure technical efficiency than scale efficiency. Banks in middle east are more efficient than banks in any other part of the world. Larger banks exhibit better results are constant returns to scale. But most of the Islamic banks are operating at diminishing returns to scale. Size of the Islamic banks is mostly big in middle east. The number of Islamic banks over increasing returns to scale has declined, which shows the efficiency of Islamic banks decreases with increase in size.
37	Moussawi and Obeid (2011)	2005–2008	DEA: Input: Total fixed assets, interest expense, personnel expenses, other operating expenses Outputs: Total earning assets, net commission revenue, total deposits Regression: Growth rate, inflation rate, equity to asset ratio, size of the bank, doubtful loans to asset ratio, return on assets.	GCC region	Data envelopment analysis, regression analysis	Productive efficiency of Islamic banks has increased but the results are dispersed. Inflation is the major factor in determining efficiency of Islamic banks. The relationship between economic growth and efficiency appears negative.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
38	Mostafa (2011)	2009	DEA: Inputs: Assets, equity, net income Ouputs: Return on assets, return on equity	Saudi Arab, Iran, Kuwait, Malaysia, Bahrain, Qatar, Turkey, Egypt, Bangladesh, Syria, Sudan, Brunei, Jordan, Pakistan, Indonesia, UK, Yemen, Singapore, Palestine,	Data envelopment analysis, sensitivity analysis	Efficiency does not have any significant relationship with profitability in Islamic banks, however, efficiency does contribute to long term performance. Changing the variables in the model changes the efficiency between 0.8 to 1.
39	Noor and Ahmad (2012a)	1992–2009	DEA: Inputs: Total deposits, labour cost, total assets Output: Total loans, income, other earning assets TOBIT and fixed effect model: Total loans divided by total assets (LOANS/TA), log of total assets (LNTA), non-performing loans divided by total loans (NPL/TL), log of total deposits (LNDEPO), operating expenses divided by total assets (OE/TA) and book value of stockholders' equity as a fraction of total assets (EQUITY/ TOTAL ASSET). Logarithm of GDP, inflation, market capitalisation (MARKET), AFC, GFC, MENA, Asian countries, and country income level (LOW, MEDIUM and HIGH)			
40	Noor and Ahmad (2012b)	1997–2009	DEA: Inputs: Deposit, labour, fixed capital Outputs: Loan and advances, income, other earning assets TOBIT: Return on equity, operating expenses/total assets, equity/total assets, natural log of total assets, loans/total assets, natural log of total deposits, natural log of GDP, inflation, market capitalisation, dummy for crisis, dummy for region.			
41	Al-Khasawneh et al. (2012)	2003–2006	DEA: Inputs: Personnel expenses, fixed assets, loanable funds net loans Outputs: Other earning assets (loans to special sectors, inter-bank loans and investment securities, total interest income/net loans, other operating income/other earning assets, as personnel expenses/total assets, non-interest expenses/ total assets, total interest expense/loanable funds.	Tunisia, Algeria, Egypt, Sudan	Data envelopment analysis	Conventional banks have increasing cost efficiencies while Islamic banks have decreasing. Revenue efficiency in Islamic banks is higher than conventional banks. Islamic banks are more successful in countries with competitive conventional systems than solely with Islamic systems.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
42	Ahmad and Rahim Abdul Rahman (2012)	2003–2007	DEA: Inputs: Total personnel expenses, net book value of property plant and equipment Outputs: Total deposits, loans and advances, total income	Malaysia	Data envelopment analysis, t-test and Mann–Whitney U-test	Most of the Islamic banks have scale inefficiency. There are two factors to pure technical efficiency managerial efficiency and technological advancement but Islamic banks suffering primarily from managerial inefficiency.
43	Abu-Alkheil et al. (2012)	2005–2008	DEA: Inputs: Deposits and short-term funding, total expenses, total staff cost Outputs: Total loans, total revenues	GCC, Turkey, Malaysia and UK	Data envelopment analysis, financial ration analysis, correlation analysis, regression analysis	Islamic banks are technically inefficient. Islamic banks in Muslim countries are more efficient than Islamic banks in non-Muslim countries. An Islamic bank should be a medium sized bank because it helps to achieve efficiencies.
44	Yahya et al. (2012)	2006–2008	DEA: Inputs: Deposits (this includes, current, savings and term deposits plus short-term borrowings), fixed assets Output: other earning assets among these assets are loans and advances to banks, securities, derivatives, investment in property, and insurance assets), and overheads, loan amount (this is inclusive of residential mortgage loans, consumer or retail loans, commercial loans less non-performing loans), interest revenue, and net income.	Malaysia	Data envelopment analysis, t-test	The efficiency of Islamic banks was below conventional banks earlier but became at par lately.
45	Said (2012)	2006–2009	DEA: Inputs: Labour cost, fixed assets, total deposits Output: Total loans, liquid assets, and other income	USA	Data envelopment analysis	There are significant changes in the efficiency of Islamic banks during and after the crisis.
46	Sufian et al. (2012)	2006–2010	DEA: Inputs: Deposits, labour, input prices: interest expenses/deposits, personnel expenses/total assets Output: Loans, income, output prices income on loans and other loans/loans, other operating income/income Generalised regression: revenue efficiency, log of total assets, loan loss reserve/gross loans, equity/total assets, bank deposit/total deposit, total loans/total asset, on-interest income/total asset, log of GDP, inflation, dummy of domestic Islamic banks, observation for banks, observation for year	Malaysia	Data envelopment method, multivariate regression analysis using generalised lease square comprising fixed effect and random effect model, Mann Whitney (Wilcoxon) test, t-test	Revenue efficiency of domestic Islamic banks remains lower than foreign Islamic banks. Capitalisation has positive effects on revenue efficiency, whereas market share, inflation and liquidity have negative effects.
47	Akhtar (2013)	2000–2009	DEA: Inputs: Deposit, labour, capital Output: Interest income, loan and advances, capital TOBIT: Efficiencies, real GDP from oil sector, oil prices, market capitalisation of banking industry, return on equity.	Saudi Arabia	Data envelopment analysis and TOBIT regression analysis	Banks in Saudi Arab remained least effected by Financial crisis but remained inefficient. Banks are mostly effected allocative inefficiency which means they are unable to find optimum mix of their inputs and outputs. Banks with large market share are better able to achieve efficiency. They is significant relationship with profitability with efficiency means banks can have profitable operations despite inefficiencies.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
48	Kablan and Yousfi (2013)	2001–2008	SFA,DEA: Inputs: Labour, physical capital, deposits Input prices: Personnel expenses/total expenses, total expenses/total assets, income for deposits/total assets, output: net loans, net liquid assets, total earning assets Regression and correlation: Cost efficiency, natural log of total cost, natural log of loans, natural log of securities, natural log of loans, natural log of personnel expenses, size, return on assets, return on equity, risk taking market power, per capital GDP, population density, risk taking, dummy UK, dummy of Islamic banking system, dummy of subprime crisis.	Iran, Jordan, Kuwait, United Arab Emirates, Qatar, Bahrain, Lebanon, Saudi Arabia, Yemen, Pakistan, Malaysia, Brunei, Sudan, Egypt, Tunisia, UK	Stochastic Frontier analysis, data envelopment analysis, regression analysis	Islamic banks in Asia are more efficient than all other regions. It is less costly for Islamic banks to operate in countries with Islamic government legislation. However, this does not guarantee cost efficiency. Profitability and market power have positive impact on efficiency of Islamic banks.
49	Fitti et al. (2013)	2005–2009	DEA: Inputs: Staff expenses, fixed assets, total deposits Outputs: Total loans, other revenues, liquid assets Regression: Asset quality, management quality, liquidity, return on assets, return on equity, bank size, market share, gross domestic product, population density, Herfindahl-Hirschmann index, equity ratio.	GCC Countries	Data envelopment analysis, regression analysis	GDP, population density and experienced management positively effects efficiency of Islamic banks.
50	Said (2013)	2006–2009	DEA: Inputs: Labour cost, fixed capital, total deposits Outputs: Total loans, liquid assets, other income Financial ratios: Credit risk (ratio of total debt to total asset), liquidity risk (equity/total asset), operational risk (EBIT/net total assets) Correlation analysis: The correlation between financial ratio analysis and efficiency analysis	MENA region	Three stage analysis: data envelopment analysis, correlation analysis, financial ratio analysis	Credit and operational risks are negatively related with efficiency while relationship of liquidity risk with efficiency is not significant in Islamic banks.
51	Sufian et al. (2013)	2006–2010	DEA: Inputs: Deposits, number of employees, physical capital, input prices: price of deposit, price of labour Outputs: Loans, investment Price of output: Price of loans, price of investment	Malaysia	Data envelopment analysis, Mann-Whitney and Wilcoxon test, Kruskall-Wallis tests	Domestic Islamic banks have lower revenue efficiency but better cost and profit efficiency than multinational Islamic and other banks. Foreign banks in Malaysia benefit from their global advantage.
52	Shahwan and Hassan (2013)	2009	Profitability efficiency: Inputs: Total deposits, total expenses, leverage Outputs: Return on assets, return on equity. Marketability efficiency: Inputs: ROA, ROE Outputs: EPS, P/E ratio Social efficiency: Inputs: Audit Committee, proportion of local executives, institutional ownership, government ownership Outputs: EPS, P/E ratio, the voluntary social disclosure score.	UAE	Data envelopment analysis	The banks have high profitability and social efficiency but are far below in marketability efficiency. Banks with high profit efficiency have high social efficiency and vice versa.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
53	Firdaus and Hosen (2013)	2010–2012	DEA: Inputs: Total deposits, total assets, labour cost Outputs: Financing, operational Income TOBIT : Efficiencies, assets , the number of the branch of the banks, ROA, ROE,CAR, NPF	Indonesia	Data envelopment analysis, TOBIT regression model	There is a huge dispersion in the efficiency score of Islamic Banks, which means that Islamic banking in Indonesia is not competent enough. Non-performing loans and capital adequacy ratios have negative impacts on the efficiency of the banks.
54	Johnes et al. (2014)	2004–2009	DEA: 1st stage variables: Inputs: Deposits and short-term funding, fixed assets, general and administrative expenses, equity Outputs: Total loans, other earning assets 2nd stage variables: inputs: assets, loan loss/loans, loan loss/assets, net loans/assets, normalised Herfindahl index, market capitalisation, growth in real GDP, inflation, GDP per capita Islamic banks need to improve on their portfolio and product management, whereas conventional banks need to improve on their performance management.	18-Countries with 60% or more Muslim Population	2-stage data envelopment analysis (DEA) and meta-frontier analysis (MFA).	Results suggest that managers of Islamic banks are efficient but Islamic banks are inefficient.
55	Sufian and Kamarudin (2014)	2004–2011	DEA: Inputs: Deposit, labour, capital Outputs: Loan, investment	Bangladesh	Slack-based data envelopment analysis	Islamic banks are not operating according to their scale of investment which is causing scale inefficiency.
56	Sufian et al. (2014)	2006–2010	DEA: Inputs: Deposits, labour, Input prices: price of deposits, price of labour Output: Loan, income Output prices: price of loan, price of investment	Malaysia	Data envelopment analysis and Mann-Whitney (Wilcoxon test), T-test	The revenue of domestic Islamic banks is lower than foreign Islamic banks. Large Islamic banks are operating at decreasing or constant returns to scale while small Islamic banks are operating at Increasing or constant returns to scale. Banks on increasing returns to scale are always target of being taken over.
57	Rosman et al. (2014)	2007–2010	DEA: Inputs: loans, other earning assets, deposits and short-term funding Outputs: fixed assets, personnel expenses. TOBIT model: Return on assets, total assets, equity/total assets, loan loss provisions/net interest expenses	Middle Eastern and Asian countries	Data envelopment analysis, TOBIT model	Islamic Banks are more technically efficient whereas Islamic Banks in Asia are even more technically efficient. Also Islamic banks have grown beyond productive scale therefore need to adjust their scale to improve their efficiency.
58	Kamarudin et al. (2014)	2007–2011	DEA: Inputs: Deposits, labour cost, loans Output: Income, price of deposits, price of labour, price of loans, price of income	GCC countries	Data envelopment analysis, Mann-Whitney and Wilcoxon test, Kruskall-Wallis tests	Conventional banks have significantly higher efficiencies than Islamic banks. Revenue efficiencies effects profit efficiencies in Islamic banks but not in conventional banks.
59	Shawtari et al. (2015)	1996–2011	DEA: Discretionary accrual proxy for earning quality, Overall Efficiency using DEA, Capital ratio, Size of the bank, Loan to Deposits, GDP, Auditor, Islamic or Non-Islamic Banks (Panel Data)	Yemen	Two stage approach using Breusch-Pagan Lagranges multiplier (LM) pooled OLS and random effects.	Islamic like conventional banks use and manipulate loan loss provisions to smooth their profitability which is a non-shariah compliant practice.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
60	Shawtari et al. (2015)	1996–2011	DEWA: Deposits, capital, labour, interest income, non-interest income, total loans, financing income, non-interest income, total financing, total loans to borrowers, total financing in case of Islamic banks. Panel regression: Dummy Islamic, natural log of GDP, natural log of inflation index, natural log of market concentration, natural log of total assets, natural log of capital structure, natural log of return on assets, natural log of loan loss provisions/total loans, natural log of non-interest income/non finance income, natural log of total loans or finances.	Yemen	Three stage data envelopment window analysis (modified DEA analysis), panel data technique with unbalanced data for regression.	Islamic banks are better than conventional banks in terms of efficiency. The profitability of Islamic banks is negatively related to their efficiency. The size of bank only matters in case of Islamic banks for enhancement of efficiencies.
61	Gheeraert and Weill (2015)	2000–2005	DEA: Inputs: Total credit to GDP, Islamic credit to GDP, conventional credit to GDP, total deposits to GDP, Islamic deposits to GDP, conventional deposits to GDP inflation, latitude, log (Y/L), log (K/L)	Algeria, Argentina, Bahrain, Bangladesh, Belize, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Cameroon, Chad, Chile, Colombia, Congo, Dem. Rep. Costa Rica, Cote d'Ivoire, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Iran, Israel, Jordan, Kenya, Kuwait, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Nepal, Niger, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Sri Lanka, Sudan, Swaziland, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Uganda, Uruguay, Venezuela, and Zambia.	Stochastic Frontier analysis, data envelopment analysis	Development of Islamic banks favors overall efficiency of the economy, however the relationship is nonlinear. Development of Islamic banking favors overall economic efficiency unless it remains under controlled parameters. Excessive growth in Islamic banking has negative effects on overall economic efficiency of the economy. The relationship of conventional banking development with economic efficiency only starts after some certain level of development is reached with conventional banking.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
62	Salami and Adewale (2015)	2002–2011	Inputs: Total deposits, capital, total loans Outputs: Income, investments,	Malaysia	Data envelopment analysis, Malmquist productivity index	The efficiency of window Islamic banks is better than the efficiency of full-fledged Islamic banks. Banks with longer years of operations are more efficient than other banks. The productivity improvement in Islamic banks is mainly due to technical efficiency improvement.
63	Zuhroh et al. (2015)	2004–2010	Inputs: Third party funds, labour, assets Input prices: Price of funds, price of labour, price of assets, loans (credit) Bifilar: Cost efficiency, assets, equity/assets, asset quality, liquidity, non-performing loans, competition.	Indonesia	Stochastic Frontier analysis, ordinary least square with maximum likelihood method, bifilar regression	Islamic banks have lower cost efficiency than conventional banks which is because of allocative efficiency. Technical efficiency of Islamic banks is higher than conventional banks. Islamic banking suffers from lack of supervision and regulations.
64	Abbas et al. (2015)	2005–2009	Inputs: Employees, fixed assets, deposits, equity Outputs: Loans and advances, investments, markup (interest) income, other income	Pakistan	Data envelopment analysis, Malmquist productivity index	The productivity of Islamic banks is higher than conventional banks. The major source of productivity decline is technological change index. Which means that Islamic banks should focus on adopting new technologies.
65	Belanès et al. (2015)	2005–2011	Inputs: Total salary expenses, fixed assets and total deposits Outputs: Total loans, other revenues and liquid assets	Saudi Arabia, UAE, Qatar, Qatar, Bahrain, Kuwait	Data envelopment analysis	Results indicate negative impact of global crisis on Islamic banks. Efficiency of Islamic banks significantly decreased after the crisis. With the decrease in efficiency many conventional banks lost their business but Islamic banks gained but to Sharia factor.
66	Bahrini (2015)	2006–2011	DEA, MMI: Inputs: Labour cost, fixed assets, total deposits Outputs: Total loans, investment portfolio, no operating income Regression: Capital adequacy, bank size, management quality, business diversification, credit risk, return on equity, loan to deposit ratio, cash to total asset ratio.	MENA Region	Data envelopment analysis, bootstrap Malmquist index, second stage regression analysis	Efficiency of Islamic banks have grown during the period. Technological progress is positively related to efficiency. Sluggish adoption to new technology also slows down productivity improvement. The growth of bank efficiency is mainly due to bank specific variables although economic factors also leave their impact. Banks in MENA region have put their focus more on scale efficiency than technical efficiency. Global financial crisis also impacted efficiency of GCC Islamic banks.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
67	Sufian and Kamarudin (2015)	2006–2011	DEA: Inputs: Deposit, labour, physical capital, input prices: price of deposit, price of labour, price of physical capital Output: Loans, investments. Regression: namely, size, asset quality, capitalisation, market share, liquidity and management quality.	Indonesia, Malaysia and Brunei	Data envelopment analysis-test, Mann-Whitney [Wilcoxon], Kruskall-Wallis) tests, OLS regression, generalised least square	There exists significant difference between local and foreign Islamic banks. Domestic banks have better revenue efficiency and foreign banks have better cost efficiency. Bank size, asset quality, capitalisation, liquidity, management quality, gross domestic product and inflation.
68	Ab-Rahim and Chiang (2016)	2000–2011	DEA: Inputs: Personnel expenses, book value of premises and fixed assets, deposits and short-term funding Outputs: Total loans and other earning assets Regression: ROA, ROE, net income margin, marketshare, market concentration, technical efficiency, scale efficiency, expenses, loan, size, HHI, size	Malaysia	Data envelopment analysis, concentration ratios, Herfindahl-Hirschman index (HHI), regression	Inefficiencies in Islamic banks are higher but these should not be dealt with mergers and acquisitions like in the case of conventional banks.
69	Abbas et al. (2016)	2004–2009	DEA efficiency model: Inputs: Employees, fixed assets, deposits Outputs: Loans and advances, investments DEA effectiveness model: Inputs: Loans and advances, investments Outputs: Mark-up interest income, other income TOBIT: Efficiency, effectiveness, performance, years of operation, owner's equity/assets, loans and advances/assets, non-performing loans/assets, log (deposits), profit (before tax)/assets, non-markup income/assets, other operating expenses/assets, square of the sum of the market shares of each bank in national market, dummy of minimum capital requirements by regulatory authority	Pakistan	Data envelopment analysis, TOBIT regression analysis	Reason for inefficiency of Islamic banks is their early age and small size. Islamic banks have increased their competitiveness with the increase in experience and size. Islamic banks are suffering from loan loss provisions. GDP growth rate and minimum capital requirements have positive effect on efficiency of Islamic banks whereas market concentration and inflation have negative effects.
70	Wanke et al. (2016)	2010–2014	DEA: Inputs: Assets, deposits, equity, outputs: provisions, operational results, personal expenses, banking products, number of employees	Middle East Including Iran; South and South East Asia; Africa and Europe	Two stage and technique for order preference by similarity to the ideal solution (TOPSIS) method with neural network analysis	The efficiency of Islamic banks recently subjected to War remains low. Major factors of Inefficiency in Islamic banks relate to cost structure and country of origin of the bank. Cultural traditions also leave positive impact on efficiency of Islamic banks. Islamic banks do not learn from their experiences due to low competition. European and Gulf-based Islamic banks are required to focus on their learning curves.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
71	Aghimien et al. (2016)	2007–2011	DEA Inputs: Total assets, deposit Outputs: Total loans, income	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE	Data envelopment analysis	Technical inefficiency in Islamic banks is mainly due to pure technical inefficiency. Scale inefficiency is quite low in Islamic banks. Large Islamic banks are operating at decreasing or constant returns to scale while small Islamic banks are operating at increasing or constant returns to scale.
72	Majeed and Zanib (2016)	2007–2014	DEA: Inputs: Deposits, fixed assets, capital, Outputs: investments, advances, assets	Pakistan	Data envelopment analysis	Conventional banks have higher technical efficiency than Islamic banks. Islamic branches of conventional banks are less efficient than Islamic banks and also enjoy better scale efficiency.
73	Mirdamadian et al. (2016)	2012	DEA: Inputs: total assets, systematic risk, non-systematic risk, return on equity, Outputs: yearly efficiency, sales growth, current ratio and earning per share	Iran	Data envelopment analysis	EPS and ROE have the most influence on efficiency of DMU's
74	Tan et al. (2016)	2016		Malaysia	Extended DEA gaps model	Service quality of an organisation is very much based internal strengths and is also effected from internal weaknesses.
75	Alqahtani et al. (2017)	1999–2012	DEA: Inputs: Islam Year, Islamic or conventional bank, state foreign or listed bank Outputs: Capital adequacy ratio, non-performing-loans, cost to income ratio, return on assets, other earning assets/total assets, natural log of fixed capital/labour expenses, natural log of total assets, inflation, GDP, Natural log of annual oil prices	GCC countries	Non-parametric data envelopment method, parametric stochastic frontier analysis with regression analysis	In the long run there is no significant difference between the cost efficiencies of Islamic and conventional banks. Conventional banks have better profit efficiency. Only Islamic banks in Bahrain have better cost and profit efficiency due to better management. During global financial crisis Islamic banks remained more cost efficient. Profit efficiency gap of Islamic and conventional banks eroded down during financial crisis period. When financial crisis remained within financial sector Islamic banks remained less effected however, when crisis spread into economy Islamic banks started to receive effects. This shows Islamic banks are more related to real sector of the economy. Domestic banks were more efficient than Islamic banks.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
76	Doumpos et al. (2017)	2000–2011	BOFSI: Equity/total assets, loan loss provision/gross loans ratio, cost/income, profits/total assets, liquid assets/deposits and short-term funding ratio. DEA: Inputs deposit, equity overhead. Output: Other assets, loans other earning assets. SFA: Interest expenses/deposits, overheads/total assets, loans other earning assets	Algeria, Bahrain, Bangladesh, Brunei, Egypt, Indonesia, Iraq, Jordan, Kuwait, Lebanon Malaysia, Mauritania Pakistan, Qatar, Saudi Arabia, Senegal, Syria, Tunisia, Turkey, UAE, Yemen	BOFSI, data envelopment analysis, stochastic Frontier analysis	Islamic banks have performed better in MENA region, however, conventional banks have performed better in Asia and Gulf region. Overall performance and efficiencies of Islamic banks are very similar to those of conventional banks.
77	Daly and Frikha (2017)	2005–2009	DEA: Inputs: Market share, income diversity, total assets. Outputs: Equity/total assets, net loans/total assets, govt. variables, efficiency	Bahrain	Data envelopment analysis, multiple regression, DWH test, Fisher-test, financial ratios	Income diversity, bank size, solvability indicators, and loans to assets ratio has positive impact on the performance of Islamic banks' (ROE). Whereas market share, solvability indicators and net loans to total assets (NL/TA) have significant effects on the ROE for conventional banks.
78	Miah and Uddin (2017)	2005–2014	DEA: Inputs: Operating costs, cost of deposits. Outputs: loan Output. Regression: Efficiencies, bank's size, earning assets, and equity buffer, Islamic bank dummy	Saudi Arab, UAE, Kuwait, Qatar, Bahrain, Oman	Data envelopment analysis, stochastic Frontier analysis, ordinary least square analysis	Conventional banks are more cost efficient than Islamic banks. Islamic banks in Qatar and Saudi Arabia Banks are developing but banks in Bahrain and Kuwait have matured up and thus have cut throat competition with their competitors however, their size is smaller. Conventional banks are oversized whereas Islamic banks undersized which is leading to diseconomies of scale. Capital adequacy ratio in the GCC region is double the Basel requirement which is also a cause of inefficiency. Islamic banks are diverse in terms of cost efficiency whereas conventional banks are homogenous. short-term efficiency of Islamic banks is higher than conventional banks.
79	Batir et al. (2017)	2005–2013	DEA: Inputs: labour, capital, funds. Outputs: Total loans, off balance sheet items, price of labour, price of physical capital, price of funds. TOBIT: Technical efficiency, cost efficiency, allocative efficiency, profitability, capital adequacy, expense, deposit, loans, loan quality (NPL), size, GDP growth, inflation.	Turkey	Date envelopment analysis and TOBIT method	Technical Efficiency is higher than Allocative efficiency for all banks. Efficiencies of Islamic banks are higher than efficiencies of conventional banks in all respects. External variables such as GDP and inflation effect both types of banks negatively.
80	Bahrini (2017)	2007–2012	DEA: Inputs: Labour, fixed assets, deposits. Outputs: Total loans, other earning assets	MENA region and GCC region	Boot strap data envelopment analysis	Pure technical inefficiency causes technical inefficiency. It has no concern with scale efficiency. Efficiency of GCC region Islamic banks remained better than the efficiency of Non-GCC region Islamic banks during the period of crisis.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
81	Ali Shah and Masood (2017)	2007–2015	Admin cost, deposit account, capital employed, commission on premium, net return margin, total loans and advances, net spread earned, total financing, gross premium, net investment income	Pakistan	Data envelopment analysis	The technical efficiency of Insurance sector is better than banking sector. Scale efficiency of conventional financial institutions is better than Islamic.
82	Azad et al. (2017b)	2009–2013	Production approach: Inputs: Interest expense, salary expenses, operating expenses Outputs: Interest income, net income Profitability approach: Inputs: Total capital, salary expense, interest expense Outputs: Total deposits, total loans Intermediation approach: Inputs: Total capital, total deposit, salary expense Outputs: Total loans	Malaysia	Two stage data envelopment analysis	Foreign banks have higher efficiencies than domestic banks. However, domestic Islamic banks are more efficient than domestic conventional banks. Islamic bank nature, foreign ownership and GDP are major determinants of bank efficiency. Efficiency scores vary according to approach and variables selection. To estimate efficiency during business cycles profitability approach should be used. Intermediation approach should be applied on long term data as it is more closer to going concern concept. Production approach gives holistic idea of bank efficiency, hence it should be applied to gauge the efficiency of the bank to serve the economy. The improvement in bank efficiency is not the phenomenon of technology and training alone, rather it also depends upon business strategy, bank's operational approach, and time of existence as well.
83	Azad et al. (2017a)	2010–2015	DEA Input: Deposit, equity, interest expense, non-interest expense. Undesirable carry over output: Non-earning assets Desired output: Liquid assets, net income Undesirable outcome: Loan loss provision Intermediary: Earning assets, loans	Malaysia	Three step NDEA model, robust regression, CAMEL	Local conventional and Islamic Banks are performing better than their foreign counterparts in terms of efficiency. Separate efficiency for each stage of operation of the bank i.e., production, intermediation and profitability should be computed. Banks inputs and outputs are related to each other i.e., by increasing inputs a proportionate output cannot be expected. Banks have different efficiencies in different stages of operation.

Table 1   Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
84	Shawtari et al. (2018)	1996–2011	DEWA: Inputs: Deposits, capital, labour. Input prices: loan/finance, interest/finance income, non-interest/finance income. Pooled OLS: Natural log of pure technical efficiency, natural log of scale efficiency, dummy of Islamic banks, natural log of GDP, natural log of inflation index, natural log of market concentration, natural log of total assets of the bank, natural log of capital/total assets, natural log of return on assets, natural log of finance provision/total finance, natural log of total non-interest income, natural log of total loans and finances for conventional and Islamic banks, natural log of liquid assets/liabilities.	Yemen	Three stage data envelopment window analysis (modified DEA analysis), pooled ordinary least square.	Islamic banks are far better than their conventional counterparts on the basis of technical and scale efficiencies. However, pure technical efficiency of conventional banks remain higher which implied Islamic banks need to invest more on human resource training.
85	Mezzi (2018)	2004–2012	DEA: Inputs: Staff cost, physical capital, total deposits. Outputs: Income paid to depositors, administrative expenditure, total debt assets, total assets of participation, debt and participation returns, other income. Regression: Size of the board of directors, number of independent directors, concentration of capital, size of shariah board, existence of a central shariah board, size of the bank, debt financing intensity, return on assets, quality management, risk of failure, financial crisis, economic growth.	Saudi Arabia, Bahrain. Bangladesh, Indonesia, Jordan, Kuwait, Malaysia, Palestine, Qatar, Sudan, Syria, Tunisia, UAE, Yemen	Data envelopment analysis, regression analysis	Islamic banks are showing improvement in cost efficiency. Malaysian and GCC Banks are realising scale efficiencies. MENA and South East Asian Banks have almost similar scale efficiencies. Board of directors and Shariah Board have significant roles in improving efficiencies. Size, financial stability, debt financing and cost control contribute significantly towards efficiency improvement.
86	Zeineb and Mensi (2018)	2004–2013	DEA: Inputs: IZ-score, CEO duality, board size, structure. Outputs: Total assets, deposit, debt ratio, credit growth, GDP.	GCC region	Data envelopment analysis, stochastic Frontier analysis, Z-score, sensitivity analysis	Banks with higher risk appear more efficient due to their governance structure. Economic conditions of a country play important role between efficiency and risk relationship.
87	Hadhek et al. (2018)	2005–2014	DEA: Inputs: Profit, number of employees, funds, net fixed assets, prices of inputs; personnel expenses/total assets, profit expenses/total deposits, operating expenses/fixed assets. Outputs: Net loans, investment bond, bond, certificate of deposit. TOBIT: GDP/total population, average rate of inflation, population density, log of total assets, equity/total assets, net profit/average total assets, total loans/total assets, costs/income	Saudi Arab, Iran, Malaysia, Pakistan, Thailand, Egypt, Qatar, Jordan, Dubai, Tunisia, Kuwait, Sharjah, Dubai, Oman, Abu Dhabi	Two stage stochastic Frontier analysis, data envelopment analysis, TOBIT regression	There exists negative relationship between bank size and profit efficiency. Inflation and demand density negatively effects profit efficiency whereas GDP effects positively. Equity ratio and operating costs negatively affect profit efficiency whereas Credit risk does not have any significant relationship.

Table 1 Literature review (continued)

Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
88	Mahdi and Abbes (2018)	2005–2016	DEA analysis: Inputs: Labour cost, fixed capital for production, financial capital. Outputs: Total loans, other earning assets, personal expenses, fixed assets, total deposits. GMM: Loan loss provisions, bank cost efficiency, loan growth rate, net interest/return margin, preprovision income, capital, loan to asset ratio, inflation, GDP	Bahrain, Iraq, Algeria, Egypt, Jordan, Kuwait, Qatar, Saudi Arabia, Palestine, Tunisia, Turkey, UAE, Yemen, Pakistan	Data envelopment analysis, stochastic Frontier analysis, generalised method of movements	Risk taking in Islamicbank is the cause of risk underestimation, over estimation of technical efficiency and future profits.
89	Bahrini and Qaffas (2018)	2006–2012	Inputs: Staff costs, fixed assets, total deposits. Outputs: Total loans, investment portfolio	Bahrain, UAE, Kuwait, Qatar, Saudi Arabia	Boot strap data envelopment analysis	Islamic banks have better technical efficiency than scale efficiency. Pure Technical inefficiency causes scale inefficiency. The efficiency scores of banks were not affected by financial crisis, be it during or after. Efficiency of Islamic banks was effected by financial crisis when it spread from financial to real sector.
90	Sakti and Mohamad (2018)	2008–2012	DEA: Total deposit, personnel expenses, fixed assets, loans, non-interest income. Regression: Size of the bank, fee income, non-deposit funding, loan deposit ratio, loss reserve, loan loss provision, non-performing loans, Z-score, return on assets, equity to asset ratio.	Indonesia	Data envelopment analysis, t-score, Z-score,	Islamic banks in Indonesia rely on non-deposit funding. Islamic banks have better assets quality. Islamic banks have better stability, overall efficiency, technical efficiency and scale efficiency.
91	Hassana et al. (2018)	2008–2016	DEA: Inputs deposits. Outputs: Assets, capital, investments, advances, income	Saudi Arabia	Data Envelopment Analysis	With the increase in scale of business the efficiency of Saudi Islamic banks have started to decline.
92	Mohtashami et al. (2018)	2009–2013	DEA: Inputs physical assets, number of employees, deposit values, operational costs. Outputs: Received commission, loan payments, investment amount, net revenue.	Iran	Two stage double frontier data envelopment analysis, Malmquist productivity index.	None of the bank has shown improvement in efficiency or productivity.
93	Nejad et al. (2018)	2018	DEA: Input: Salaries, employee benefits. Outputs: Branch profitability	Iran	DEA	Employee benefits lead to improved productivity of the bank branches.

Table 1   Literature review (continued)

| Sr	Authors	Period	Efficiency variables	Country(ies)	Efficiency model	Conclusion
94	Chaffai and Hassan (2019)	2002–2014	DEA: Inputs: Personnel expenses, book value of fixed assets, interest expenses, Outputs: total loans, other earning assets, and deposits.	Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen	Stochastic Frontier analysis	Conventional banks are more efficient than Islamic banks in terms of technological, managerial and allocative efficiency. Banks in MENA region need to introduce more products and introduce more technology to improve their efficiency. The technological efficiency is higher in larger banks. Foreign bank status has no impact on efficiency. Online banking is important driver of cost efficiency.
95	Hafez and Halim (2019)	2003–2008	DEA: Inputs: Total deposits, assets Outputs: Total loans income	Egypt	DEA	Before financial crisis conventional banks outperformed Islamic window banks and Islamic banks. After financial crisis Islamic banks have better.
96	Johnes et al. (2019)	2006–2012	For financial ratio analysis: cost to income ratio, non-interest expense to average assets ratio, net interest margin, other operating income to average assets, return on average assets, return on average equity.	GCC Countries	Financial ratio analysis and extended data envelopment analysis, i.e., Malmquist productivity index with standard two component composition	Cost efficiency of Islamic banks is lower than conventional banks; revenue efficiency is similar; Variations in technical efficiency and technology are more pronounced in Islamic banks. The blend of Islamic and conventional banks improves the ability of banking system to absorb external shocks; besides the distinction of Islamic and conventional, the distinction within Islamic banks in terms of product lines and specialisation. Islamic banks can improve their cost efficiency by adopting latest information technology speculations.
97	Wanke et al. (2019)	2006–2014	Inputs: Loans Outputs: Total assets and equity Contextual variables: bank ownership, type, and origin are assessed as exogenous factors. Country of origin represents the endogenous factor.	MENA	Dynamic DEA	The results reveal that bank type, origin, and ownership impact efficiency levels differently in terms of profit sheet, balance sheet, and financial health indicators, although the impact of culture and regulatory barriers seem to prevail at the country level.
98	Samad (2019)	2008–2012	DEA: Inputs: Labour, capital, deposits, and expenses; Outputs: Loans, investments in securities, and advances TOBIT: Capital adequacy, asset quality, management quality, cost efficiency, liquidity index, bank size.	Bangladesh	DEA with TOBIT Analysis, SFA, CAMEL and CAMEL plus Model	Efficiency of Islamic banks is positively related to capital adequacy ratio and number of branches and negatively related to poor loan quality, higher liquidity claim and bank size.
99	Saljoughia et al. (2019)	2012–2013	Choice of input out variables depends upon various factors. No single input out combination is applicable on all banks in operation	Fortune 500 List	DEA	DEA is a useful technique to identify inefficient units. Each inefficient bank can set its own bench marks input output variables and can accordingly improve their performance.

3 Conceptual framework of Islamic bank efficiency

The proposed conceptual framework for efficiency analysis of Islamic banks identifies three essential domains that must be followed. First domain is the research motivation i.e., the purpose of ascertaining the efficiency. Various motivations for Islamic bank efficiencies have been identified in research motivation box of Figure 17. Having decided research motivation second domain is the choice of input-output variables. The choice of inputs and outputs must coincide with research motivation. Various choices for inputs and outputs used by researchers around the globe have been mentioned in choice of input-output variables box of Figure 17. Third and final domain is structure and competency level of existing Islamic banking arrangements. Various choices in this regard have been mentioned in efficiencies in global regions box of Figure 17.

4 Analysis of results

An account of various efficiency trends has been depicted in Figures 1 to 16. Figures 1 and 2 depict technical efficiency trends and comparison between Islamic and conventional banks. The figures reveal that technical efficiencies of conventional banks all around the regions whereas technical efficiency of MENA region has received pronounced effects of financial crisis. The figures suggest that conventional banks of Asia have performed slightly better than others during the period of crisis. Figure 1 also reveals an interesting finding that Islamic banks of Asia pacific region have outperformed their conventional and Islamic counterparts in terms of improving their technical efficiencies as they are now the leading region. Figures 3 and 4 depict pure efficiency trends and comparison between Islamic and conventional banks. This analysis shows an interesting finding that Islamic banks received least effect of financial crisis. An important finding which complements our findings from the analysis of Figures 1 and 2 is the fact that Asia pacific region has shown significant progress in terms of pure technical efficiency.
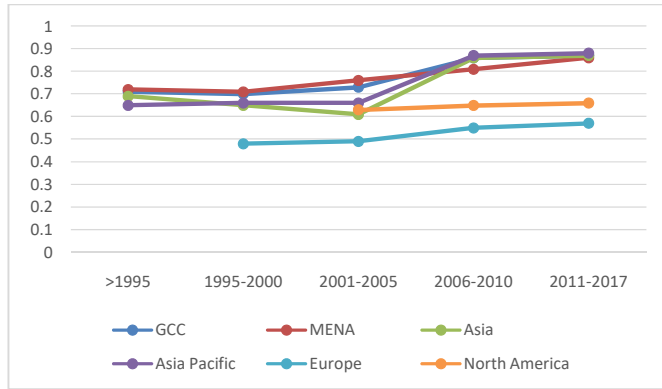
Figure 1 Technical efficiency trend Islamic banking (see online version for colours)
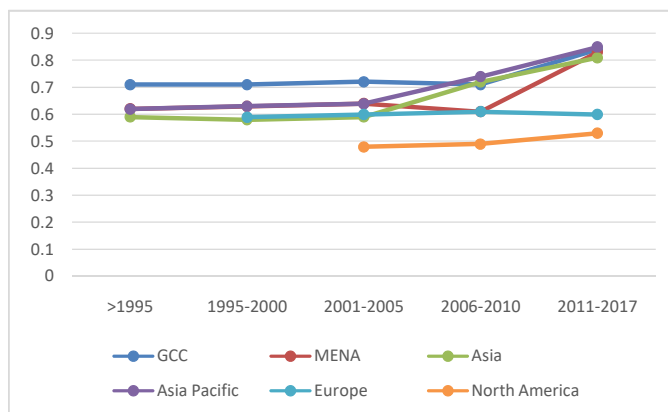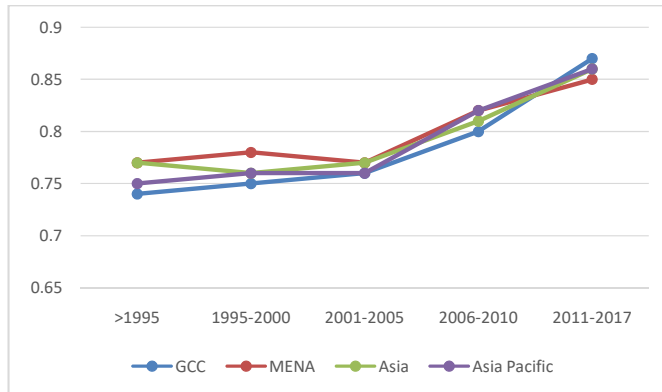
Figure 2 Technical efficiency trend conventional banking (see online version for colours)
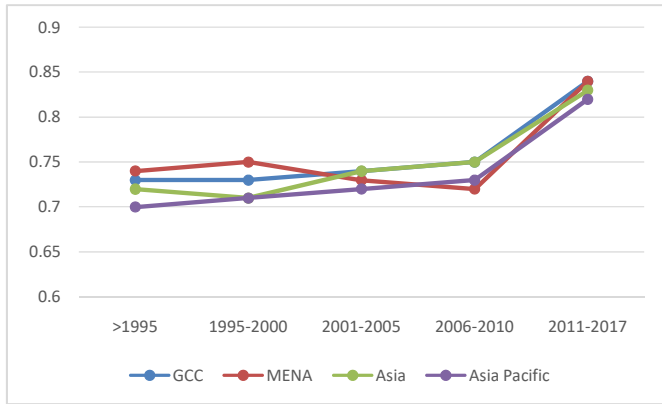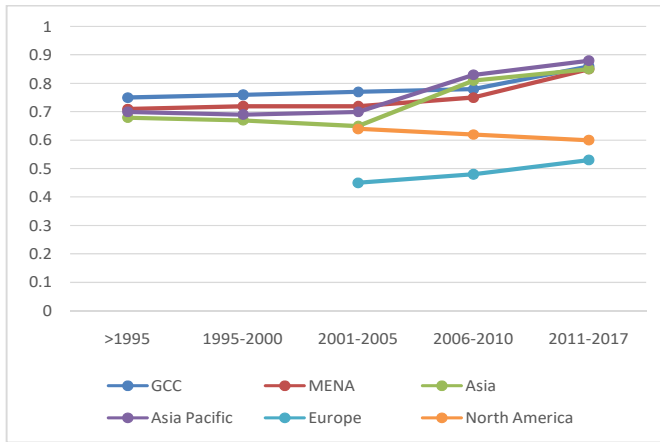

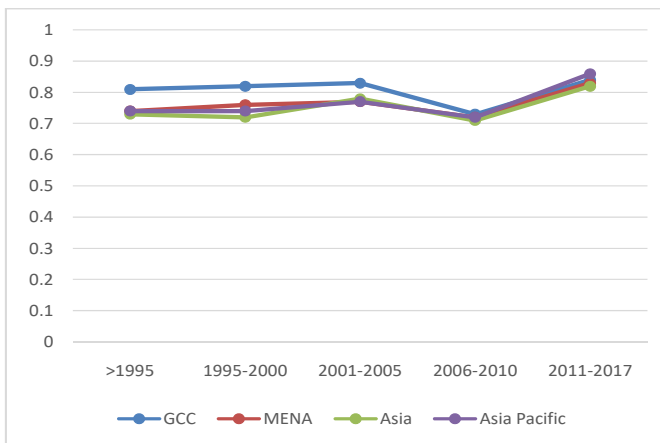**Figure 3** Pure technical efficiency trend Islamic banking (see online version for colours)

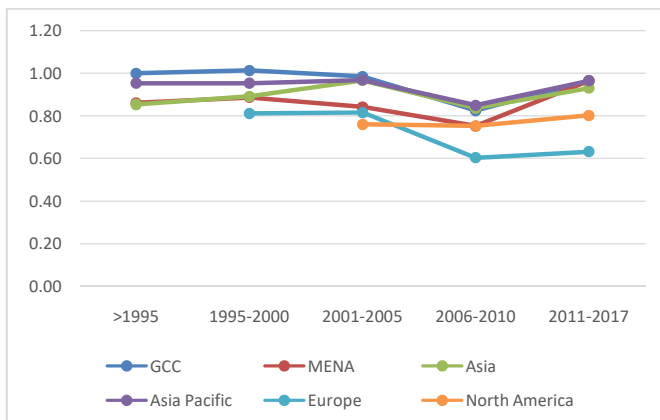**Figure 4** Pure technical efficiency conventional banking (see online version for colours)

Figure 5 Allocative efficiency trend Islamic banking (see online version for colours)
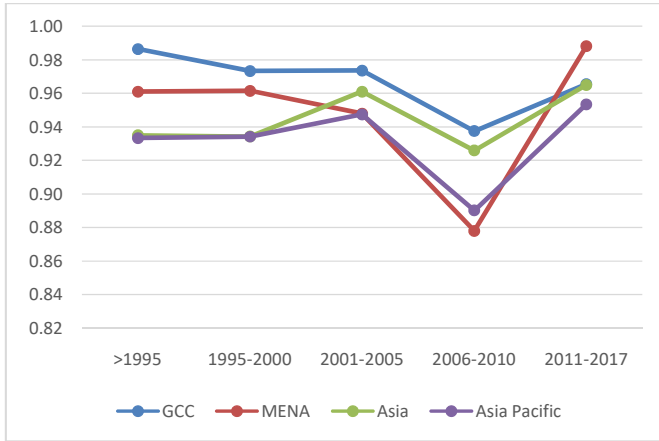

Figure 6 Allocative efficiency trend conventional banking (see online version for colours)
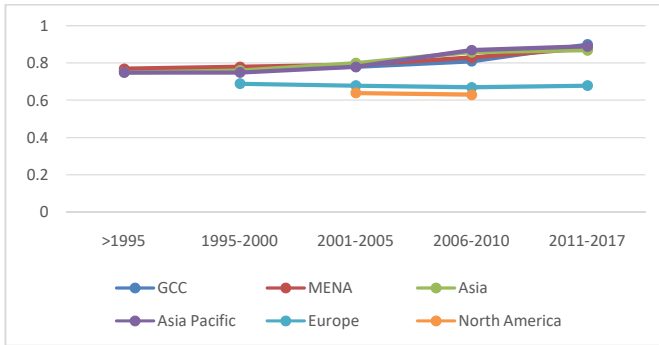

Figure 7 Scale efficiency trend Islamic banking (see online version for colours)
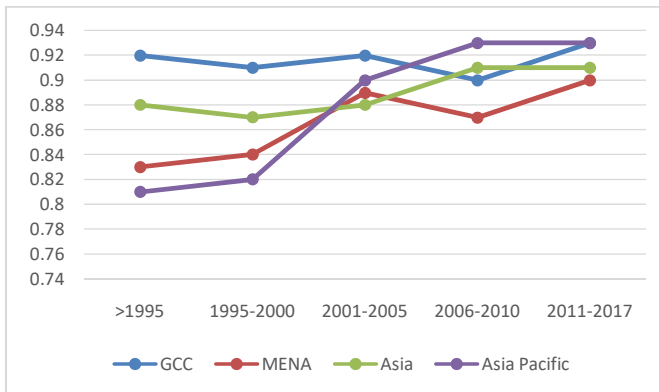
Figure 8   Scale efficiency trend conventional banking (see online version for colours)
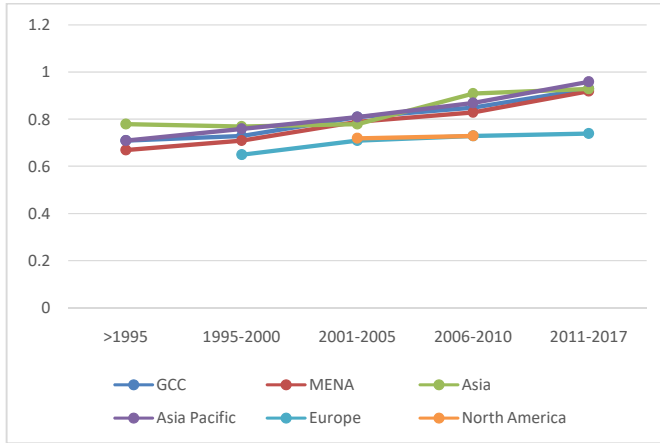

Figure 9   Cost efficiency trend Islamic banking (see online version for colours)
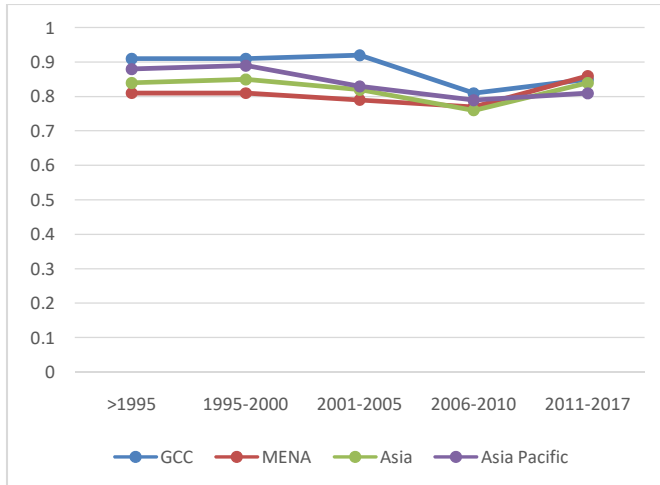

Figure 10   Cost efficiency trend conventional banking (see online version for colours)

Figure 11 Revenue efficiency trend Islamic banking (see online version for colours)

Figure 12 Revenue efficiency trend conventional banking (see online version for colours)

Figure 13 Profit efficiency trend Islamic banking (see online version for colours)

Figure 14   Profit efficiency trend conventional banking (see online version for colours)
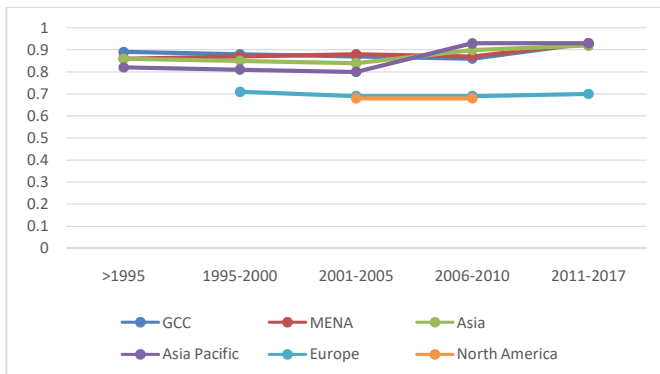

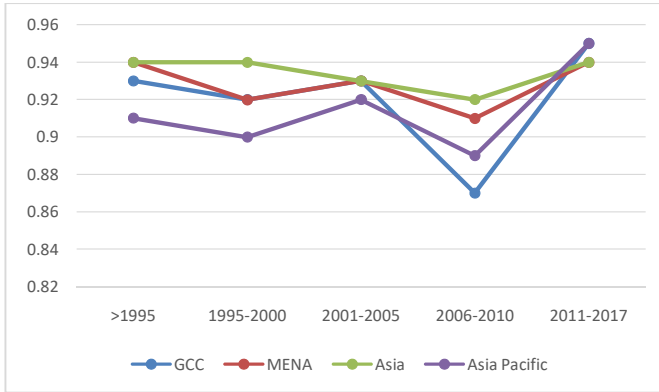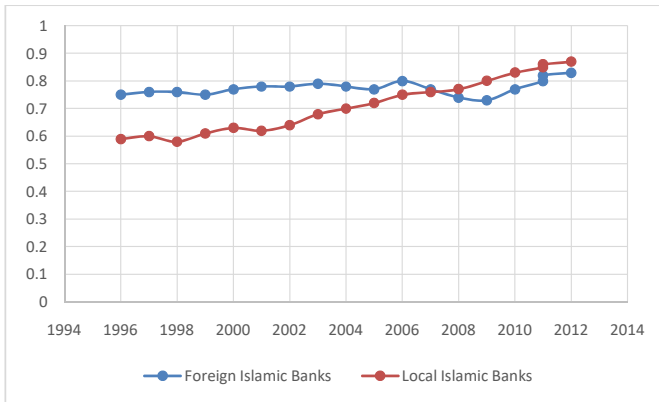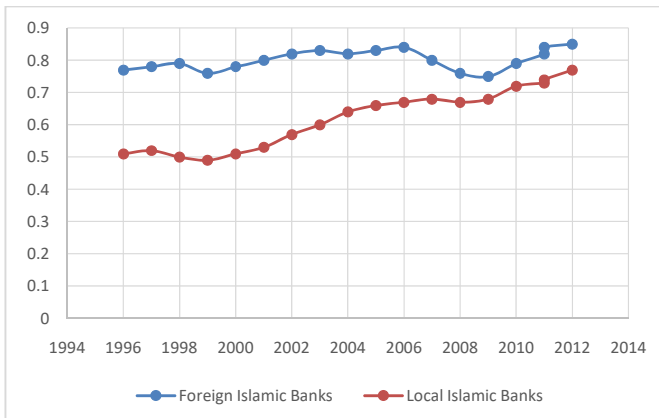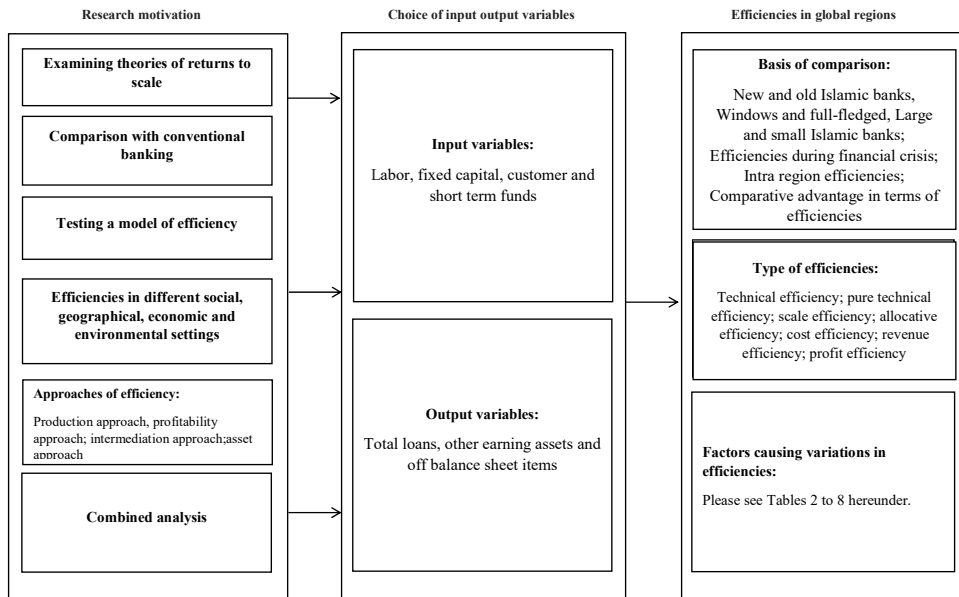**Figure 15**   Revenue efficiency foreign and domestic Islamic banks (see online version for colours)

Figure 16   Revenue efficiency foreign and domestic Islamic banks (see online version for colours)

Figure 17 Conceptual framework of Islamic bank efficiency

Research motivation	Choice of input output variables	Efficiencies in global regions
Examining theories of returns to scale	**Input variables:** Labor, fixed capital, customer and short term funds	**Basis of comparison:** New and old Islamic banks, Windows and full-fledged, Large and small Islamic banks; Efficiencies during financial crisis; Intra region efficiencies; Comparative advantage in terms of efficiencies
Comparison with conventional banking		
Testing a model of efficiency		**Type of efficiencies:** Technical efficiency; pure technical efficiency; scale efficiency; allocative efficiency; cost efficiency; revenue efficiency; profit efficiency
Efficiencies in different social, geographical, economic and environmental settings		
Approaches of efficiency: Production approach, profitability approach; intermediation approach;asset approach	**Output variables:** Total loans, other earning assets and off balance sheet items	**Factors causing variations in efficiencies:** Please see Tables 2 to 8 hereunder.
Combined analysis		

Figures 5 and 6 depict allocative efficiency trends and comparisons between Islamic and conventional banks which has also received pronounced effects of financial crisis. Asia pacific region here again depicts significant improvements in terms of allocative efficiency. Besides, these figures also reveal slow growth in the productivity of Islamic banks in Europe and American regions; hence these are the regions which need to be looked upon. Figures 7 and 8 reveal scale efficiency trends in Islamic and conventional banking. These figures depict the most pronounced effects of financial crisis on Islamic and conventional banks. These figures lead us to an interesting find that scale efficiency receives the most effect of financial crisis be it Islamic or conventional banks, therefore, this type of efficiency can also be used as a predictor of financial crisis. Having said that however, Islamic banks have performed better than their conventional counterparts in terms of scale efficiency as well, whereas scale efficiency behaviour of banks in GCC region, be it Islamic or conventional, was very much similar which shows the openness of GCC region towards western world.

Figures 9 and 10 depict cost efficiency trends and comparison between Islamic and conventional banks. This efficiency reveals more pronounced effects of financial crisis in GCC and MENA regions. These figures also depict Asia pacific and Asian regions taking lead in terms of cost efficiency over the period of time. However, an interesting finding is the fact that Asia and Asia pacific regions have shown improvement in cost efficiency in Islamic and conventional banking. Figures 11 and 12 reveal revenue efficiency trends and comparison between Islamic and conventional banking. An analysis of these figures reveal more pronounced effects of crisis on conventional banking as compared with Islamic banking. Here again, Asia Pacific region has shown more pronounced developments than all other regions. Figures 13 and 14 depict profit efficiency trends and comparison between Islamic and conventional banking. The effects of financial crisis in these figures are also more pronounced in the case of conventional banks. In terms of

regions GCC has been the most affected and Asia being the least from crisis. An interesting finding in these figures is the fact that Islamic banks in Asia and Asia Pacific regions have shown improvement in profit efficiency even during the periods of crisis. Furthermore, profit efficiency across the regions in Islamic banks appears to converge towards a similar trend.

Though efficiency analysis of Islamic and conventional banks can be conducted from various perspectives for instance, new and old Islamic banks, windows and full-fledged, large and small Islamic banks, etc., however, due to lack of availability of diversified and in-depth literature we present a further analysis only from foreign and domestic Islamic banks in Figures 15 and 16. An analysis of Figures 15 and 16 shows that over the period of time domestic Islamic banks have able to improve their revenue efficiency above foreign Islamic banks but their cost efficiency has remained lower.

5   Conclusions

Research in Islamic banking using efficiency model started somewhere in the beginning of 21st century. Initial works are led by Hassan (2003) and Hussein (2003). According to Hassan and Aliyu (2018), the research in Islamic finance can be divided into two eras' i.e., before 1980s and after 1980s with after 1980s being the era of research where the researchers in Islamic banking started focusing on empirical work. Earlier studies in after 1980s era were mostly focused on bank efficiency analysis and its comparison with conventional banks. However, in recent studies, the scope of research has been extended to financial crisis, financial inclusion and working for social, economic, regulatory and Shariah factors that contribute to efficiencies.

A review of literature on Islamic banks can be made on several accounts such as Hassan and Aliyu (2018). However, we have made a more specific account of literature focusing input-output approach comparing it with conventional banking. An account of our findings has been given hereunder:

5.1   Returns to scale

An account of researches reveals that Islamic banks are not operating on optimum returns to scale. For instance, novice Islamic banks are operating on increasing returns to scale whereas old Islamic banks are operating on decreasing returns to scale. These bring problems of mergers and takeovers for novice banks and diseconomies of scale for larger commercial banks. Further window Islamic banks were close to optimum returns to scale as compared with full-fledged Islamic banks. Window Islamic banks when converted to full-fledged Islamic banks started to encounter similar returns to scale problems as other Islamic banks meaning thereby conventional banks supervision effects the operations of Islamic banks.

5.2   Choice of variables

Various studies have utilised different sets of variables for efficiencies. This appears logical because Islamic models followed in various parts of the world are not the same. Further, it has also been discovered that while calculating various efficiencies, change of variable(s) do not bring change in efficiency score more than an absolute value of '0.2',

i.e., even if in order to make comparisons, we change underperforming financial variables with better performing financial variables the efficiency scores will not improve more than an absolute value of '0.2' and vice versa. Therefore, in order to compare the results of Islamic banks across the boundaries an adjustment of 0.2 may be applied keeping in view the results and change in the nature of variables.

Over the period of time it has been established that the most effective input variables are labour, fixed capital and customer & short term funds; while total loans, other earning assets and off balance sheet items are effective outputs. Lastly, various regression models have been applied for determining factors that contribute to various efficiencies however, TOBIT regression analysis has been recommended as the most effective.

5.3 Application of law of variable proportions:

An analysis of efficiency trends under the ambit of laws of returns leads us to the conclusion that on overall basis, excluding the effects of financial crisis 2008, Islamic banking is in the first stage of law of variable proportion i.e., increasing returns to scale where Asia pacific region has taken the lead. This shows the novice status of Islamic banking which requires thorough supervision and support anywhere in the world. In order to reap the benefits of scale with expansion in Islamic banks, continuous protections from various factors are required. The factors include increasing operational costs, Shariah compliance cost, competition from conventional banks, protection from foreign banks, economic shocks and delays in learning curve due to inability of appropriate human resources.

5.4 Factors to efficiency

Tables 1 to 7 present detailed descriptions of factors that contribute to various efficiencies over the period of last 20 years grouped into periods of five years. An analysis of tables reveals that with the growth of Islamic banks the factors that affect various efficiencies have been increased. The factors that affect technical, pure technical, scale and allocative efficiencies are profitability, regulatory support, size, solely Islamic system, technology, Shariah board and board of directors. With respect to cost efficiency it has been observed that Shariah compliance cost has a critical role which deters Islamic banks to compete. Besides it has also been observed that over the period of time sole existence of Islamic system has been reversed. In the early years of Islamic banking, countries which had sole Islamic systems such as Iran and Sudan showed better efficiency than the countries with mixed systems. However, with the expansion of Islamic banking dual system of Islamic and conventional banking provided better resilience and stability. Also, the countries where Islamic banks competed with conventional banking, Islamic banks showed better results than the countries where Islamic banks had no conventional competitors. Lately, it has also been observed that banks with more Shariah compliant products tend to show better revenue efficiency than even their Islamic competitors. Furthermore, lack of product diversification also reduces allocative efficiency and eventually increases risks which also had negative relationship with various bank efficiencies. In terms of foreign and domestic banks, it has been observed that foreign banks are able to improve their cost efficiencies by introducing sophisticated technology but they suffer to compete in terms of revenue efficiency

because it requires competition in local markets where local banks hold better market share.

Table 2   Technical efficiency

Period	Factors
> 1995	Profitability, regulatory support, size, solely Islamic system
1995–2000	Profitability, regulatory support, size, solely Islamic system
2001–2005	Profit, size, competitive Islamic and conventional system, NPL, low market share, GDP, Sharia rules
2006–2010	Bank size has negative and profitability have no relationship with efficiency, technical efficiency is related with operating expenses, asset size, equity, non-performing loans, average fixed costs and GDP, risk management efficiency affects technical efficiency, credit and operational risk have negative affect on efficiency
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Shariah board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Latest technology improves cost, technical and scale efficiencies.

Table 3   Pure technical efficiency

Period	Factors
> 1995	Profitability, regulatory support, size of the bank, new tech, solely Islamic system
1995–2000	Profitability, regulatory support, size, new tech, solely Islamic system
2001–2005	Profitability, size, competitive Islamic and conventional banking system, NPL, low market share, GDP, Shariah rules
2006–2010	Bank size has negative impact and profitability have no relationship with efficiency, managerial efficiency and technological advancement are factors to scale efficiency, credit and operational risk have negative affect on efficiency.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Sharia board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Latest technology improves cost, technical and scale efficiencies.

Table 4   Allocative efficiency

Period	Factors
> 1995	Profitability, regulatory support, size, new tech, solely Islamic system
1995–2000	Profitability, regulatory support, size, new tech, solely Islamic system
2001–2005	Profit, size, competitive ISLAMIC and conventional system, NPL, low share, GDP, Sariah rules
2006–2010	Bank size has negative impact and profitability have no relationship with efficiency, credit and operational risk have negative affect on efficiency.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Shariah board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Latest technology improves cost, technical and scale efficiencies.

Table 5 Scale efficiency

Period	Factors
> 1995	Profitability, regulatory support, size, new technology, solely Islamic system
1995–2000	Profitability, regulatory support, size, new tech, solely Islamic system
2001–2005	Profit, size, competitive Islamic and conventional system, NPL, low market share, GDP, Shariah rules
2006–2010	Bank size has negative impact and profitability have no relationship with efficiency, technological advancement are factors to scale efficiency.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Shariah board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Latest technology improves cost, technical and scale efficiencies.

Table 6 Cost efficiency

Period	Factors
> 1995	Joint ownership, Shariah compliance, staff expenses +ve, profit, regulatory support, solely Islamic system
1995–2000	Joint ownership, Shariah compliance, staff expenses +ve, profit, regulatory support, solely Islamic system
2001–2005	Profit, size, competitive Islam and conventional system, capital to asset ratio, loan to asset ratio, population density, NPL, low Mshare, GDP, Shariah rules, previous capital -ve,
2006–2010	Profitability, market share +ve, Shariah comp –ve. cost efficiency of banks in countries with Islamic legislation is better, credit and operational risk have negative affect on efficiency.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and S. board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Latest technology improves cost, technical and scale efficiencies.

Table 7 Revenue efficiency

Period	Factors
> 1995	Joint ownership, Shariah comp, staff expensive +ve, profitability, regulatory support, solely Islamic system
1995–2000	Joint ownership, Shariah comp, staff expenses +ve, profitability, regulatory support, solely Islamic system
2001–2005	Profit, size, competitive Islam and conventional system, NPL, low market share, GDP, Shariah rules
2006–2010	Profitability and market share have positive effects on efficiency, credit and operational risk have negative affect on efficiency.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Shariah board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Competitive system of banking increase efficiencies of the bank. Product development, product diversification improves revenue and profit efficiency.

Table 8   Profit efficiency

Period	Factors
> 1995	Joint ownership, Shariah compliance, staff expenses +ve, regulatory support, solely Islamic system
1995–2000	Joint ownership, Shariah compliance, staff expenses +ve, regulatory support, solely Islamic system
2001–2005	Profit, size, competitive Islamic and conventional system, NPL, low Mshare, GDP, Shariah rules
2006–2010	Profitability and market share have positive effects on efficiency, credit and operational risk have negative affect on efficiency. Revenue Efficiencies effect profit efficiencies in Islamic banks only.
2011–2017	Bank size and profits have negative relationship with efficiencies. BOD and Shariah board have significant impact on improving efficiencies. Higher appetite for risks contribute to technical and scale efficiencies. Competitive system of banking increase efficiencies of the bank. Product development, product diversification improves revenue and profit efficiency.

6   Limitation, implications and future research directions of the research study

Content and bibliometric analysis suffers from its own limitations (Apriliyanti and Alon, 2017). For instance, researches are available only from a particular source. To address this issue we have included papers from ISI database, Scopus and Google Scholar. Though Islamic banks have cost inefficiencies due to Shariah compliance, they have better managerial capacities as depicted by technical efficiencies and pure technical efficiencies. This is the indication of long term capabilities. It further requires that Islamic banks should continue evolving their capabilities regarding risk management, technological advancements, compliance and operational costs. There is a need to improve financial practices and modalities in order to address advanced requirements of the competitive financial world. Most of the Islamic banks and even researchers are focusing using conventional risk management mechanisms measures in Islamic settings. The results of our study show that there is a need to develop risk management models for Islamic banks keeping in view their domestic requirements. An important future research direction stemming from literature is based on the fact that Islamic banks started to receive effect of financial crisis after two years (Hassan and Aliyu, 2018). Rigorous studies are required to be conducted in this area that why Islamic banks were dragged into recession when all the economies were into recovery phase. This shows the lagged nature of Islamic banking system which needs to be worked on from academic, professional, policy making and research point of view!

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