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Efficiency assessment of banking sector in Yemen using data envelopment window analysis: A comparative analysis of Islamic and conventional banks

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Abstract

Purpose – The purpose of this paper is to examine the banking industry's efficiency using the case of Yemen.

Design/methodology/approach – The paper utilises two-stage analysis to evaluate the efficiency adopting Data Envelopment Window Analysis (DEWA) in the first stage for the period 1996-2011. Furthermore, the paper addresses, in two-dimensional matrix, the stability and efficiency of the banking sector in order to assess their ability for survival. In the second stage, panel data analysis is applied to regress a set of bank-specific and macro-economic variables on the efficiency of the banking sector in Yemen in a comparative fashion between Islamic and conventional banks.

Findings – The findings of the investigation indicate that the Yemeni banking industry in general was on a declining efficiency's trend with increased instability during the later period of the investigation. In addition, the study shows that most conventional banks were relatively stable, though inefficient, while Islamic banks were more efficient over the time. The results of panel data regression further suggest that efficiency is related to a number of determinants. Loan/financing, and profitability are the common key determinants of efficiency for both Islamic and conventional banks. However, other determinants have impacted differently for Islamic and conventional banks, which could reflect the uniqueness of their operation and structure.

Research limitations/implications – The present study provides a basis for the regulators and bankers to assess the viability of the banking sector and proposes policies to restructure the industry in order to enhance the performance of the whole industry.

Originality/value – The paper presents new empirical findings on the efficiency of Islamic and conventional banks in Yemen.

Keywords Data envelopment analysis, Business performance

Paper type Research paper

1. Introduction

The Republic of Yemen is classified as a Least Developed Country (LDC) with an economy that has passed through the gradual change of restructuring its underdeveloped economic system towards a transition to a market-based economic system[1]. According to a report on Yemen by US Commercial Service (2008), Yemen faced several challenges such as the large volume of non-performing loans, low capitalisation, and weak enforcement of

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regulatory standards, which have hampered attempts to improve the banking sector. Nonetheless, there is rapid growth and development in Yemen's financial and banking sectors. Such growth has been fuelled by the introduction of financial reforms and the liberalisation of the financial sector, which have contributed substantially to increased competition, and the entry of a number of new banks with particular reference to Islamic banks[2]. Few years after the liberalisation process, the players in the banking industry have doubled from eight to 16 banks. Due to the absence of a capital market, the Yemeni banking system constitutes the linchpin and backbone of the Yemeni financial system, although it remains underdeveloped. A very important component of the overall economy and one of the main drivers of the development process (Al-Swidi and Mahmood, 2011). Evidently, there is huge expansion in the total assets of the banking system from USD1.5 billion in 2000 to USD9 billion in 2010 (Central Bank of Yemen, 2010). This suggests the huge contribution and the significance of the banking system to the economic landscape (Zolait *et al.*, 2008). The substantial increase in the assets of the banking sector can be attributed to the emergence of Islamic banks in the late 1990s and the tremendous speed of innovation and introduction of new financial instruments.

The incentive behind the introduction of Islamic banks was based on the advice from the International Monetary Fund (IMF) and World Bank as part of financial sector reforms in order to absorb the circulation of money out of the monetary system. The banking sector in its entirety held less than 60 per cent of the money supply and the remainder of the economy operates with cash (Qatinah, 2012). It was the anticipation of the IMF and World Bank that Islamic banks in Yemen would resolve the problem of cash circulation out of the momentary system and hence the large portion of savings could be attracted as deposits into Islamic banks as Yemenis' reluctant to deal with conventional banks is attributed to a religious factor. Therefore, Islamic banks could be a viable alternative for them.

In response to all this, there was an urgent need for the reformation of the Yemeni banking sector so as to align with the international standards and to face the challenges of the new era of liberalisation. As such, the Central Bank of Yemen (CBY) has initiated several reforms to upgrade the banking system in order to improve the overall performance and tighten the financial system to protect depositors and shareholders.

The essential premise of the reformation of the Yemeni banking sector is to heighten the banking sector in the areas of legal and regulatory framework, monitoring and supervision, credit risk management, liquidity, and auditing, among others. Among the most important of the CBY was to enhance the capital adequacy requirement from Yemeni riyal (YR) 1.2 billion to YR6 billion commencing from 2004. Beyond that, CBY has allowed conventional banks to participate in the Islamic finance market, which is considered as further pressure on the whole banking industry, with specific reference to Islamic banks. The expectation is that these reforms can better align the banking sector to the international standards amidst global changes. Consequently, the banking sector would experience an improvement in their efficiency with positive spillover and influence on other banking operations. This is because the efficiency can be reflected in the banks' ability to reduce their intermediation costs and charge the public lower margins leading to an increase in its market share in line with the efficient-structure hypothesis. Therefore, the ability of banks to charge lower costs will engender trust among customers and the increased demand for financial service will subsequently affect the entire economy.

With this preliminary in mind, this study aims to first evaluate the efficiency of conventional and Islamic banks in Yemen by adopting a moving average principle (DEA windows). Second, the paper aims to provide an extension where a dimensional matrix is developed to address the current state of the Yemeni banking sector in terms of stability and efficiency. Such analysis would provide a basis for regulators and banks to further search for improvements and refinements of the industry. Third, to examine the key determinants of efficiency of the Yemeni banking sector and to test the behaviour of these determinants according to the banking model.

The motivation of this study arises from the notion that banking sector efficiency is of importance for the Yemeni economy as the only source of funds for the business community, given the absence of a capital market. Although few studies have examined banking sector performance and efficiency, to the best knowledge of the researchers, to date no study has compared the efficiency of Islamic and conventional banks over a significant period. Moreover, this is the first study in Yemen to use a unique method, namely Data Envelopment Window Analysis (DEWA) to estimate efficiency scores. The method provides a greater degree of freedom that would enhance the accuracy of the estimated efficiency scores. This study thus attempts to fill the void identified in the existing literature. It is in this sense that this effort aspires to significantly contribute to the literature.

To achieve the objectives of this study, the study adopts the DEWA proposed by Charnes *et al.* (1985) rather than standard DEA to consider the dynamism effects. Asmild *et al.* (2004) contended that DEWA is based on the principle of moving average that fits the estimation of a bank's efficiency over time as it treats each bank in a different period as if it was a different unit. The efficiency of each DMU in a specific period is contrasted with its own efficiency in other periods as well as to the efficiency of other DMUs. Halkos and Tzeremes (2009) opined that such a method provides a better alternative to provide a solution for a small sample and have estimates that are more robust. Despite a wide range of literature on efficiency of the banking sector, the application of DEA to the specific case of Yemen to evaluate the efficiency of the banking sector has only recently started to gain attention.

2. Literature review

Several studies have investigated the efficiency of the conventional and Islamic banking sector globally. Most studies have utilised standard DEA to analyse the bank's efficiency across countries (Sufian, 2011; Zimkova, 2014; Tsionas *et al.*, 2015; Wozniewska, 2008; Ajlouni *et al.*, 2011; Ahmad Mokhtar *et al.*, 2008; Hassan *et al.*, 2009; Bader *et al.*, 2008). Among the recent cross-countries comparative studies on efficiency is the study conducted by Said (2012) that investigated the efficiency of different banks worldwide. It focused on the change of efficiency of small conventional and Islamic banks for the 2007-2009 period, during the economic downturn to provide evidence on whether the financial crisis has brought a negative impact on the efficiency of the conventional and Islamic banks. The researcher utilised the DEA non-parametric test to examine efficiency. The findings revealed no significant difference in efficiency between small and large conventional banks for 2007. However, for 2008 and 2009, there was a significant difference in the efficiency of small and large conventional banks. On the other hand, there was evidence of significant difference as between small conventional banks and Islamic banks for the three years (2007-2009). The results suggested that Islamic banks have sustained their efficiency during the three years of economic downturn.

As for the present study, it places emphasis on DEA windows analysis. Among the studies to have adopted this analyse of efficiency are Avkiran (2004), Canhoto and Dermine (2003), Sufian (2007), and Webb (2003). Webb (2003) utilised the DEA windows based on a five-year period to examine the efficinecy levels of large retail banks in the UK for the 1982-1995 period. In line with the intermdiation approach, the results revealed that pure technical inefficiency is not an issue, while the scale inefficiency is considerd the source of overall inefficiency. Larger banks were found to be more technically efficient than other banks. Reisman *et al.* (2003) examined the efficiency over time for a sample of banks in Tunsia using DEWA. The results of the study showed that the efficiency scores for post libralization period have improved. Besides, the privately owned banks were shown to be less technically efficient than other banks. State-owned banks expereinced lower scale efficeincy in the later period and technical efficiency in early years.

In another study coducted by Sufian (2007), the efficiecny estimation was undertaken for the sample of Singapore banks for the years 1993-2003 adopting narrow windows width of a three-years. Various ouputs have been utilised (total loans and other income) with correpsonding outputs (total deposits and fixed assets). The results of the study provided evidence that efficiency of selected Singaporean banks have decline in the early period of observation and improved in subsequent years. Furthremore, the findings indicate that large banks underperformed compared to small banks in all efficiency types. Similarly, Avkiran (2004) adopted a three-year window width in order to estimate the efficiency scores of a sample of Australian banks. The study showed similar results with Sufian (2007), where the estimation of efficiency in early years of observation showed low efficiency with subsequent improvement in the later period. The main cause of lower efficiency scores in the Australian banks was the pure technical inefficiency rather than scale efficiency.

Using a similar approach, Gu and Yue (2011) reported the results of efficiency estimation for a sample of Chinese listed companes, in which they found that any change in technical efficiency and pure technical efficieny will be reflected in stock return. However, the scale efficiency is not related to stock return. They further reported that technical efficiency and pure technical efficiency is more informative than ROE. Recently, Řepková (2014) examined the efficiency of the Czech banking sector using DEA windows analysis. The results of this study showed that larger banks are less efficinent compared to other banks. This was mainly because large banks had huge deposits and an inappropriate size of operations. Based on the above discussion of the literature, it can be seen that there is a gap in studies of efficiency estimation of banks in Yemen.

3. Data and methodology

3.1 Data

Based on data set runs over 1996-2011 for all banks, the present paper estimates the efficiency levels of banks in Yemen using DEWA. The sample examined here consists of all banks operating in Yemen during the period of analysis (1996-2011). In total, there are 16 commercial banks operating in Yemen, of which four are Islamic and the remainder are conventional. Thus, all 16 banks are covered by the analysis, as these banks offer similar financial services. The period specified above allow us to evaluate the efficiency of banking sector more appropriatly in a comparative manner as the first Islamic bank emerged in 1995. In addition, this period falls post libralisation of the banking sector of Yemen. Financial data of the study was collected from the annual report of the banks and the official web site of the IMF.

3.2 First stage analysis of efficiency estimation

3.2.1 Selection of variables. The selection of input and output variable to be used in the efficiency model is adapted from previous literature and the availability of data (Sufian and Habibullah, 2010; Sufian, 2011; Ahmed and Abdul Rahman, 2012; Piyu, 1992; Miller and Noulas, 1996). In order to select the appropriate apporach of testing efficiency, it is of importance to formulate the right theory of bank production as a way of defining the inputs and outputs. In this study, we assume that intermediation approach fits as a widely used approach which assumes that banks are intermediators for financial services. The primary function of intermediation is the process of collecting money from depositors on the supply side and channelling them to the borrowers on the demand side using, labour and capital. This approach views banks as financial intermediaries that combine labour, deposits and capital in order to produce loans and other investment or earnings assets and income (Drake, 2001; Webb, 2003). Following the intermediation approach and consistent with the prior literature, bank outputs are (y1) interest income, (y2) non-interest income and (y3) total loans. While this applies to conventional banking, the Islamic banking structure differs, and for the latter the outputs are financing income (FI), non-interest income (NII) and total financing (TF). Interest income or financing income includes those revenues from interest or income from loans or financing. Non-interest income would be similar in both modes of banking where it consists of fees and commission income. The third output refers to the total loans to borrowers in case of conventional banks and the total financing in case of Islamic banks. To produce the outputs, banks need to have (x1) deposits, (x2) labour and (x3) capital.

3.2.2 Technique adopted: DEWA. DEA in a non-parametric method used to estimate the efficiency of decision making units (DMUs). Generally, DEA is argued to be a superior method for estimating efficiency due to the following reasons. First, it allows the evaluation of relative efficiency for a set of organisations based on theoretical optimal performance for every organisation (Campisi and Costa, 2008). Second, it relaxes the assumption of distributional forms for errors or functional forms assumption and is characterised by its ability to use multi-inputs and multi-output variables (Ahmad Mokhtar *et al.*, 2008). Third, DEA is more appropriate in cases where the sample is small and where the parametric tests are not suitable (Avkiran, 2004; Canhoto and Dermine, 2003; Sufian, 2007). Fourth, in comparison to the parametric test, Seiford and Thrall (1990) put forward their argument that this approach is directed to frontier and not central tendencies, and instead of trying to fit a regression plan through the centre of the data, one "floats" a piecewise linear surface to rest on top of the observations. Thus, DEA is very unique as it estimates the efficiency of a DMU relative to all other DMUs with the simple restriction that all DMUs lie on or "below" the efficient frontier.

Building on that, DEA based on windows analysis was used to estimate the efficiency scores. The basic idea of this method rests mainly on the principle of moving averge. Kisielewska *et al.* (2005) argued that using moving average principles "DEA windows" fits best whenever the research's focus is on changes in efficiency over time. As proposed by Charnes *et al.* (1985) DEWA was introduced to detect the efficiency trends and variations over time. Principally, the procedures are to consider each DMU as if it were a different DMU in each period, thus, the efficiency of a bank in a particular period is contrasted with its own efficiency in other periods in addition to other DMUs (Halkos and Tzeremes, 2009; Sufian, 2007). According to Piyu (1992), this helps us in identifying the best and worst performers among the banks as well as the most stable

and most variable banks. Avkiran (2004) opined that moving average method or window analysis enable the calcauation of ceraltive efficiency over time. He further argued that this kind of analysis tends to be more on sensetivity analysis. As mentioned previously, the data of each DMU is considered different in each window, which enhances the degree of freedom due to the increase in the number of DMUs. The main advantage of this is to imrpove the the discriminatory power of the method which commonly uses a small sample to avoid robustness-related problems (Avkiran, 2004; Danijela *et al.*, 2012; Halkos and Tzeremes, 2009).

Although there is an argument which highlights the possibility of technical changes within each window, Asmild *et al.* (2004) suggested that window width must be narrow in order to have a robust estimation for the efficiency scores. To serve the objective of this study and in line with other literature (Sufian, 2007; Kisielewska *et al.*, 2005; Halkos and Tzeremes, 2009; Avkiran, 2004), three-window analysis will be followed. To illustrate the construction of the windows, it can be highlighted that the first window includes years 1996-1998. If the analysis is conducted in the first window, then the second window is introduced and the new window moves on a one year period and the analysis is conducted to the next three year set, where the first year "orgnial year" is dropped and replaced by a new year into the window. The process will be repeated until the final window, which includes the years 2009-2011. Through this process over the investigation period, a total number of 581 observations will be produced. For more detials on windows' construction, Table I shows a beakdown of the three years windows width.

For the DEA estimation to be valid, Banker *et al.* (1984) and Raab and Lichty (2002) suggested that the number of institutions (DMUs) under investigation should be at least three times the number of inputs and outputs variables included in the study. As this study utilises the DEWA, the minimum number of observations in each year is 32, which is broad enough to meaningfully examine the efficiency of banks.

3.3 Second stage analysis: panel data econometric model

To complement the efficiency estimate in the first stage discussed previously, the literature suggests that a two-stage approach would be appropriate to examine efficiency of banks. In specific term, there are certain variables related to the environmental forces and which could have an impact on efficiency where such factors are not traditional inputs and outputs and not under the control of managers (Coelli *et al.*, 1998). Therefore, it would

Window 1	1996	1997	1998												
Window 2		1997	1998	1999											
Window 3			1998	1999	2000										
Window 4				1999	2000	2001									
Window 5					2000	2001	2002								
Window 6						2001	2002	2003							
Window 7							2002	2003	2004						
Window 8								2003	2004	2005					
Window 9									2004	2005	2006				
Window 10										2005	2006	2007			
Window 11											2006	2007	2008		
Window 12												2007	2008	2009	
Window 13													2008	2009	2010
Window 14														2008	2010	2011

Table I.
Windows breakdown

be appropriate to use a two-stage analysis, which involves solving DEWA score in the first stage; and in the second stage, the efficiency score from the first stage, is used as the dependent variable to be regressed against the explanatory variables comprising both micro variables and macro-economic variables (Sufian and Habibullah, 2010). This should mitigate the concern that the DEA has a disadvantage in which it interprets the random errors as inefficient, making it sensitive to outlier and degree of freedom (Sufian and Habibullah, 2010). Banker (1993) and Banker and Natarajan (2004), Banker and Natarajan (2008) and McDonald (2009) provided evidence that the use of a two-stage method yields consistent estimators of the regression coefficients. A panel data technique with unbalanced data is used to regress the determinants of efficiency as panel data using random effects or fixed would help to adjust for firms-specific and time effects to avoid a biasness and and misspecification of the models (Hsiao, 2003). Other recent studies that have utilised the panle data tecniques following the efficiency estimation using DEWA (Halkos and Tzeremes, 2009; Huang *et al.*, 2012).

The following model is to be tested. Eight variables are included to reflect the bank-level characteristics, while macro-economic variables are indicated by three variables, namely GDP, inflation and concentration:

$$\mathrm{TE} = \alpha + \beta 1 DummyIslamic + \beta 2\mathrm{LN(GDP)} + \beta 3\mathrm{LN(INF)} + \beta 4\mathrm{LN(CONC)} + \beta 5\mathrm{LN(size)} + \beta 6\mathrm{CAP} + \beta 7 ROA + \beta 8 CR + \beta 9 NII + \beta 10 TLTA + \beta 10 + \varepsilon$$

- Dummy Islamic: to indicate whether there is a difference in the efficiency of conventional and Islamic banks after the micro and macro economics variables have been taken into consideration. Fundamentally, it is argued that Islamic banks in general and those in Yemen in particular, are expected to be less efficient than conventional banks due to their relatively short history and the higher operation costs arising from developing and introducing new instruments. With long experience in the market, the ability of conventional banks to produce at lower costs compared to Islamic banks favourably impacts on their costs structure, and efficiency as well (Bader *et al.*, 2008). However, in the case of Yemen, one can argue that Islamic banks in Yemen are more efficient than conventional banks for the following reasons: The mode of financing in Yemen is mostly based on Murabahah contracts and less on Mudarabah, Musharakah and Istisna with no other complex financial instruments. Second, the financing process relies heavily on relationship base so that, less monitoring and screening costs are involved. Third, within the context of the Yemeni culture, the acceptability of Islamic banks in Yemen is higher than conventional banks, which enables them to gain a higher market share in terms of both financing and deposits thereby yielding lower costs due to economies of scale.
- Ln (GPP) is used to reflect the economic development and is expected to positively affect the efficiency of the banks. GDP may influence the demand for financial services which is affected by GDP growth which would influence the efficiency of banks.
- Ln (Inf) is used to reflect the price index. Inflation is an important determinant of bank efficiency. According to Boyd *et al.* (2001) and Ben Naceur and Ghazouani (2005), high levels of inflation potentially can adversely affect economic growth and the financial sector performance. This is because economic growth positively affects the financial sector performance (Barro, 1995).

- Ln (CONC) represents the market concentration. It is measured by the assets of largest three banks in the industry. The level of concentration in the banking industry would positively influence the efficiency of banks in Yemen. This is consistent with the structure-conduct-performance (SCP) hypothesis which suggests that banks in highly concentrated market tend to collude and earn monopoly profits.
- Ln (size) is used as a proxy for size and measured by the value of total assets. Size is expected ot be related to efficiency positively benefiting from the economies of scale (Sufian and Habibullah, 2010).
- Ln (CAP) represents the capital structure requirement (capital/assets) which is a very sensitive factor in the banking industry. Well-capitalised banks can withstand the headwinds better and are less likely to go bankrupt in the face of a crisis and provide a more comfortable place for the depositors to channel their savings. Thus, the efficiency level is expected to positively related to the bank capital structure.
- Ln (ROA) (net income/total assets) is a measure for profitability and is anticipated to be associated positively with efficiency. This is mainly because the bank with a higher level of profitability is more attractive for depositors than others and their creditworthiness is higher than that of less profitable banks which creates incentives and opportunities for banks to be efficient (Sufian and Habibullah, 2010; Ioanna *et al.*, 2013).
- Ln (CR) is measured by loan loss provision to total loans and included in the model as a determinant of efficiency albeit as a proxy for credit risk. High credit risk is associated with low efficiency, as more bad loans will reduce the profitability of the banks. This is because a decline in the quality of the loan portfolio would lead to lower profitability (Miller and Noulas, 1996).
- Ln (NII/NFI) is an off-balance-sheet item (non-interest income/non finance income) and would contribute positively to the efficiency of the banks, and these items generate large portions of income for the banks by way of diversification of business (Sufian, 2009).
- Ln (TL/TA) reflects the total loans for conventional banks and total finance in case of Islamic banks. It indicates the market power in terms of loans/finance. The higher the loans/finance result in greater efficiency and efficient operation (Sufian and Habibullah, 2010).

The above model is estimated using random and fixed effects which is more appropriate with standard error correction for heteroscedasticity and autocorrelation. Descriptive statistics of the variables included in the model are reported in Table II. There are several differences between Islamic and conventionsl banks as indicated in Table II. The Islamic banks are shown to have lower standard deviation compared to their conventional banks indicaitng the stability of Islamic banks.

4. Empirical results

4.1 First stage results: overall efficiency

Using DEWA, the current paper assesses the efficiency of banks in a comparative fashion between Islamic and conventional banks. In line with the first objective of the study, Table III shows the average efficiency of all banks based on moving average

Variable	Mean			Max			Min			SD		
	All	CBs	IBs	All	CBs	IBs	All	CBs	IBs	All	CBs	IBs
GDP[a]	3,067	3,152	3,037	7,217	7,217	7,217	741	741	741	1,815	1,813	1,825
INF	11.33	11.33	11.33	38.78	38.70	38.78	3.67	3.67	3.67	5.24	5.32	5.00
C3	0.450	0.580	0.450	0.585	0.580	0.585	0.428	0.428	0.428	0.023	0.023	0.022
SIZE[a]	54,796	52,903	60,176	379,844	529,032	379,844	966	2,404	966	64,880	55,030	86,944
CAP	0.128	0.122	0.144	0.740	0.740	0.631	0.008	0.007	0.044	0.128	0.138	0.091
ROA	0.014	0.013	0.014	0.275	0.275	0.584	−0.046	−0.023	−0.046	0.018	0.018	0.018
LLP/TL	0.06	0.073	0.022	0.653	0.653	0.110	0.000	0.000	0.000	0.100	0.108	0.022
NII/TA	0.017	0.017	0.017	0.302	0.302	0.104	0.000	0.000	0.000	0.028	0.03	0.018
TL/TA	0.300	0.230	0.414	0.872	0.820	0.870	0.0001	0.003	0.064	0.185	0.183	0.150

Notes: All, all banks; CBs is conventional banks and IBs refers to Islamic banks; [a]GDP and size figures are in billion Yemeni Riya

Table II.
Descriptive statistics for efficiency determinants

Table III.
DEWA results (window length (W) = 3)

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	Mean/bank	SD
NBY (CB)	0.29	0.35	0.3	0.32	0.22	0.28	0.34	0.35	0.44	0.6	0.66	0.69	0.49	0.56	0.42	0.15
CBY (CB)	0.86	0.8	0.75	0.82	0.71	0.58	0.58	0.51	0.45	0.47	0.47	0.52	0.47	0.45	0.60	0.15
CACB (CB)	0.88	0.77	0.78	0.72	0.8	0.72	0.72	0.44	0.32	0.32	0.32	0.39	0.38	0.34	0.56	0.22
YDRB (CB)	0.61	0.61	0.47	0.38	0.33	0.47	0.47	0.56	0.48	0.53	0.53	0.65	0.68	0.38	0.51	0.11
IBOY (CB)	1.00	1.00	0.92	0.8	0.84	0.72	0.72	0.73	0.88	0.87	0.87	0.65	0.75	0.87	0.83	0.11
YKBI (CB)	0.73	0.71	0.7	0.63	0.52	0.53	0.5	0.57	0.5	0.47	0.47	0.5	0.44	0.44	0.55	0.10
QATAR (CB)												0.18	0.32	0.17	0.22	0.08
ARABB (CB)	0.77	0.55	0.43	0.39	0.43	0.4	0.4	0.49	0.55	0.66	0.66	0.81	0.71	0.6	0.56	0.14
RAFED (CB)	0.98	1.00	0.83	0.7	1.00	1.00	1.00	0.74	0.61	0.65	0.65	1.00	0.74	0.69	0.83	0.16
ULB (CB)		0.32	0.65	0.51	0.52	0.53	0.53	0.8	0.83	1.00	1.00	0.96	0.9	0.89	0.73	0.23
CALB (CB)		1.00	0.71	0.87	0.68	0.75	0.75	0.83	0.93	0.95	0.95	0.87	0.64	0.52	0.80	0.14
GULFB (CB)				0.23	0.34	0.55	0.55	0.87	0.75						0.55	0.24
TIB (IB)	0.85	0.83	0.92	0.95	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.94	0.97	0.99	0.96	0.06
SABA (IB)	1.00	1.00	0.8	0.61	0.47	0.48	0.48	0.58	0.62	0.73	0.73	0.85	0.82	0.84	0.72	0.18
IBOD (IB)	0.49	0.59	0.67	0.81	0.97	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.89	0.18
SHAMIL (IB)						0.47	0.47	0.56	0.66	0.64	0.64	0.77	0.82	0.66	0.63	0.12
Mean/W	0.77	0.73	0.69	0.62	0.63	0.63	0.70	0.67	0.67	0.71	0.69	0.72	0.67	0.63	0.65	0.15

Notes: CB, conventional banks; IB, Islamic bank

windows of three years[3]. As previously stated, 14 windows were constructed for the entire period. Table III bears witness to the trend and stability of efficiency scores. It shows that the overall efficiency score of banking sector in Yemen was ranging between 77 and 62 per cent throughout all windows. On average, the process of the estimation of overall efficiency levels showed that the banking industry witnessed a low levels of efficiency to the tune of 65 per cent. This provides evidence that the Yemeni Banking sector was underperforming and unable to carry out its main function efficiently. In performing the intermediation function, the banks found it difficult to transform their deposits into loans, which caused the banking sector to waste an average input of about 38 and 23 per cent. This is presumably because banks in Yemen faced obstacles in making investments due to poor socioeconomic conditions exacerbated by the Yemeni culture of relying on microenterprise, which may have contributed to the low loansto-deposits ratio in the banking sector (Breitschopf, 1999). Generally, Table III indicated that trends of efficiency of banking sectors showed a declining trend over the period of investigation. While the average technical efficiency score (TE) was at its peak in window 1 (77 per cent), it is immediately apparent that there was a steady decline in the average efficiency levels to lowest level in window 4 (62 per cent). Although in later period, the efficiency scores increased slightly, but still at lower levels compared to early periods. This suggests that the inputs wastage has increased in later periods of investigation. As shown in Table III, the most efficient bank was Tadhamon Islamic Bank (TIB) with average efficiency of 96 per cent with standard deviation of 6 per cent. While National Bank of Yemen (NBY), a government owned bank, was the less efficient bank in Yemen over the time with average efficiency of 42 per cent[4].

Viewing the efficiency from a competition perspective, it may be argued that the entry of Islamic banks in 1996 would affect competition positively and lead to the enhancement of efficiency level. However, the result was contrary to any such expectation. In fact, the level of efficiency has declined over time following the entry of Islamic banks. In the view of the researchers, the entrance of Islamic banks has led conventional banks to lose their market share and weaken their ability to generate deposits and produce loans. Therefore, the efficiency level of conventional banks (e.g. CBY, CAC, IBOY) has declined, as can be seen in Table III. The efficiency movements of Islamic and conventional banks were in the opposite directions. While Islamic banks experienced an uptrend in their efficiency scores over the time, the conventional banks were in a downtrend over the entire period as shown in Figures 1 and 2.

4.2 Stability of the banking sector

For the second objective, the banks were grouped into four dimesions according to their stability and efficiency.This has been done by using average efficiency and

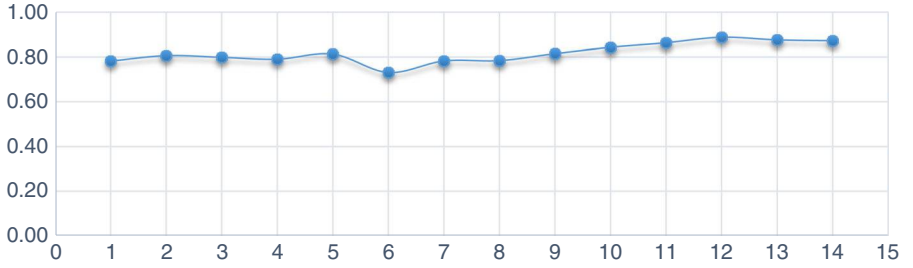

Figure 1.
Average efficiency of conventional banks over 14 indows

standard deviation of each bank in respect to the industry average as a benchmark for all banks. Table IV shows that four dimesions of stability and efficiency of banks.

As indicated in Table IV, the benchmark for calssfying the banks is based on whether the bank average score of efficiency respected average standard deviation is in line, higher or below the indsutry benchmark. As illustrated in Table IV, each bank falls into one of the four quadrants based on its characteristics.

The first group: it is apparent that this group includes banks with high efficiency and low stability. Under this group, four banks were classified as being efficient, but there is varaiblity in their performance. These banks are Al-Refdeen Bank (RAFEED), United Limited Bank (ULB), Saba'a Islamic Banks (SABA'A), and the Islamic Bank of Development (IBOD). The management of the banks should strive for findings ways to maintain the stability, while boosting the efficiency further. Causes for their efficiency's variability need to be investigated and solutions need be provided so as to improve their stability and maintain their high performance.

The second group: the banks in this group are banks with low efficiency and low stability, which includes the Coop. and Agricultural Credit Bank (CACB) and Yemen Gulf Bank (GulfB). The efficiency of this group is low and the variability is high which means seroius action must be taken by the management.

The third group: it contains the most stable and efficient banks in Yemen. This group includes only three bank namely, TIB, International Bank of Yemen and the Calyon Bank (CALB) (conventional). Banks under this quadrant can best be described as the outperformers and therefore keeping such a pack is advantageous. However, consideration for performance enhancement in the era of gloabilzation and stiff competition is higly desirable.

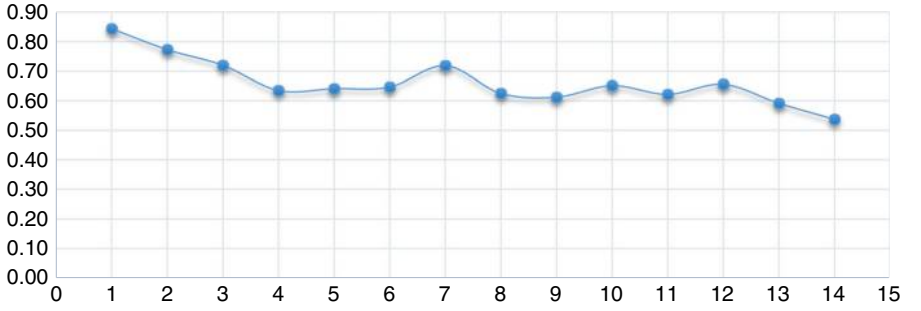

Figure 2.
Average efficiency of Islamic banks over 14 windows

Efficiency	High	First group (Banks with high efficiency and low stability) RAFDEEN, ULB, SABA, IBOD	Third group ((Banks with High Efficiency and high stability) TIB, IBOY, CALB
	Low	Second Group (Banks with low efficiency and low stability) CACB, Gulf B	Fourth Group (Banks with low efficiency and high stability) YRDB, YKBI, Qatar, ARABB, SHAMIL, NBY, CBY
		Low	High
			Stability

Table IV.
Efficiency and stability matrix

The fourth group: it includes almost half of the banks in the indsutry. They are performing with low efficiency and are consistent with no improvement. The banks in the group are Yemen Bank for Reconstruction and Development (YRDB), Yemen Kuwait Bank for Investment (YKBI), Qatar National Bank (Qatar), Arab Bank Limited (ARABB), Shamil Bank of Yemen and Bahrain (Shamil), NBY, and the Commercial Bank of Yemen (CBY). What is more important for this group is to enhance their efficiency levels, as they are mostly stable. Overall, this group of banks can be considered the main source of inefficiency in the banking sector. The management of these banks should consider addressing their the low performance.

In conclusion, the Islamic banks are reported to be efficient with some variablity in performance in two banks. In contrast, convnetional banks are deemed to be inefficient, albeit stable banks.

4.3 Second stage results

To test the third objective of the study, initially, pooled ordinary least squares (OLS) is estimated with various diagnostic tests for heteroskedasticity and serial autocorrelation The Breusch-Pagan/Cook-Weisberg test and the White (1980) show that existance of heteroskedasticity at the 1 per cent level of significance. Serial autocorrelation was conducted using Wooldridge (2002) test, and the results showed that the first order autocorrelation is likley to be a problem under 10 per cent level of significant. A collinearity test was conducted using the Pearson correlation matrix as shown in Table V. The results of the test suggests that there is no indicator of collinearity among the explanatory variables.

Since the data used in this study are based on panel data, it is worthwhile choosing the appropriate regression test to be used as an analytical tool and to interpret the data based on. Initially, pooled OLS is applied and the result of the test are shown in the Table VI, panel A. Based on the results of pooled OLS, a further test is conducted to decide on the suitability of pooled OLS against random effects. The results of random effects test is presented in Table VI, panel B. A comparison test between the pooled OLS and random effects result is conducted using the Lagrange Muliplier (LM) test (Breusch and Pagan, 1980). The LM test concludes that random efftects is more appropriate than pooled OLS. Therefore, the findings will be interpreted based on random effects[5]. The model is run with Rogers (1993) standard errors correction for both heteroscedasticity and autocorrelation[6].

Overall the results show that after adding the macroeconomic and micro variables, Islamic banks have outperformed conventional banks in their overall efficiency scores in all models reported in panel B. The results are in contradiction with other results reported by Johnes *et al.* (2014) which showed that Islamic banks

Variable	GDP	INF	C3	SIZE	CAP	ROA	LLP/TL	NII/TA	TL/TA
GDP	1.00								
INF	0.02	1.00							
C3	−0.24	0.50	1.00						
SIZE	0.56	−0.02	−0.13	1.00					
CAP	0.19	0.04	0.04	−0.29	1.00				
ROA	0.13	0.03	−0.01	−0.04	0.27	1.00			
LLP/TL	−0.12	0.00	0.03	−0.21	0.27	0.07	1.00		
NII/TA	0.01	−0.02	0.01	−0.15	0.29	0.12	0.04	1.00	
TL/TA	−0.13	0.01	−0.02	−0.04	−0.18	−0.22	−0.28	−0.03	1.00

Table V. Pearson correlation matrix

Variable	Panel A: pooled OLS Model 1	Model 2	Model 3	Panel B: random effects Model 1	Model 2	Model 3
Dummy Islamic bank	0.296	0.269	0.251	0.309	0.231	0.219
	(0.034)*	(0.037)*	(0.036)*	(0.085)*	(0.053)*	(0.051)*
LN(GDP)	0.021		0.204	0.028		0.180
	(0.032)		(0.051)*	(0.028)		(0.055)*
LN(INF)	−0.019		−0.039	−0.021		−0.042
	(0.042)		(0.040)	(0.038)		(0.037)
LN(C3)	0.292		0.854	0.268		0.831
	(0.466)		(0.425)**	(0.415)		(0.386)**
LN(SIZE)		−0.071	−0.152		−0.035	−0.122
		(0.017)*	(0.025)*		(0.018)***	(0.030)*
LN(CAP)		−0.708	−0.149		−0.056	−0.118
		(0.032)**	(0.036)*		(0.035)	(0.038)*
LN(ROA)		0.002	0.056		0.122	0.147
		(0.107)	(0.103)		(0.104)	(0.102)
LN(LLP/TL)		−0.022	−0.021		−0.008	−0.002
		(0.016)	(0.016)		(0.018)	(0.018)
LN(NII/TA)		−0.097	−0.085		−0.057	−0.048
		(0.024)*	(0.023)*		(0.024)**	(0.024)**
LN(TL/TA)		0.103	0.128		0.142	0.164
		(0.029)*	(0.029)*		(0.032)*	(0.033)*
Overall R^2	0.088	0.184	0.215	0.08	0.149	0.187
Within R^2				0.004	0.058	0.079
Between R^2				0.132	0.571	0.593

Notes: The number in parentheses are the standard errors; Regression Model:

$$EFF = \alpha + \beta 1LN(GDP) + \beta 2Ln(INF) + \beta 3Ln(CON) + \beta 4LN(SIZE) + \beta 5Ln(CAP) + \beta 6Ln(ROA) + \beta 7Ln(CR) + \beta 8Ln(NII) + \beta 9Ln(TLTA) + \beta 10\ Dummy\ Islamic + \varepsilon$$

where GDP is the macroeconomic measure of the soundness of economy; INF measures the price index; C3 refers to the concentration index; size is measured by total assets; CAP is the total equity to total assets; ROA measures the profitability; LLP/TL represents the credit risk; NII/TA measures the non-interest/finance income; TL/TA measures the intensity of loans/finance provided to customers; and finally dummy Islamic is used to differentiate the efficiency of Islamic and conventional banks. *,**,***Significant level at 1, 5, and 10 per cent level, respectively

Table VI. Efficiency determinants based on pooled OLS and random effects

were less efficient compared to conventional banks. In the context of Yemen, the demand for Islamic bank services is more vibrant due to religiosity, which is a more sensitive factor determining the appropriate bank model. This enables Islamic banks to acquire a higher market share, generating greater output disproportionately to their inputs.

With regard to the impact of determinants on the efficiency in the Yemeni banking sector, the result in Table VI show that GDP influenced the efficiency positively at 1 per cent level of significance only when it is included in the model with micro variables. This is supported by Sufian (2009) and Johnes *et al.* (2014) on the grounds that the healthier the economic situation, the better the performance of the banks. This is so because the demand for banking services increases as the economy grows, reflecting the increased wealth. A lower demand for financial services, accompanied by high probability of loans default, would lead to a decrease in national output.

The concentration index ($C3$) is significant and positively related to efficiency at 5 per cent level of significance, which underscores the importance of market concentration in determining the efficiency of banks. The results are consistent with the study of Pasiourasa and Kosmidou (2007) that found an evidence of positive relationship between concentration and efficiency of foreign banks. Although more concentrated markets are posited to be characterised by less market discipline that in turn lowers bank efficiency, the literature suggests that concentration weakens competition by fostering collusive behaviour among firms through pricing and investment policies, and this in turn influences corporate performance positively. Under the SCP paradigm, a highly concentrated market leads to collusion among large firms, thereby enhancing market power in term of higher prices and profitability (Williams, 2012; Mahathanaseth and Tauer, 2012; Mirzaei *et al.*, 2013).

With regard to micro factors, bank size (SIZE) shows a negative and significant relationship with efficiency at 1 per cent level of significance. The negative coefficient indicates that larger banks have high levels of inefficiency or "low levels of efficiency" which is consistent with other studies conducted by Pasiourasa and Kosmidou (2007), Sufian and Habibullah (2010) and Johnes *et al.* (2014). Isik and Hassan (2002) arrived at similar results for the Turkish banks. Sufian (2011) argued that a negative relationship between profitability and size could indicate increased diversification, and accordingly lower credit risks with simultaneous lower returns. According to Pasiourasa and Kosmidou (2007), one possible reason for the negative relationship relates to the economies of scale and scope for the smaller banks or diseconomies for the larger banks where only smaller banks can benefit from economies of scale up to certain sizes beyond which it would be disadvantageous.

CAP is related negatively to efficiency at 1 per cent level of significance as presented in Table VI. An increase in the capital of the banks leads to a decline in the efficiency of banks. The results are in line with the findings of Sufian (2009) who argued that the less efficient banks could have been involved in more risky operations and investment, with a need to hold more equity for the sake of the banks' safety or regulatory pressures that mandate riskier banks to carry more equity. This is contrary to the moral hazard theory, which argues that when a larger ratio of equity-capital is at risk, managers have more incentives to monitor bank efficiency (Tecles and Tabak, 2010). Overall, the findings imply that more efficient banks rely less on equity compared to their counterparts.

With respect to non-interest/non-financing income, NII/NFI, the findings show a negative and significant association with efficiency at 5 per cent level of significance. The findings are consistent with Sufian and Habibullah (2010) and suggest that a rising proportion of incomes from non-traditional activities tends to influence the efficiency negatively. It could be argued that well managed and efficient banks are less dependent on NII/NFI. In addition, Stiroh and Rumble (2006) suggest that the diversification benefits are less likely to increase the efficiency, as the diversification generated from non-interest/financing activities are much more volatile, but not necessarily more profitable than lending or financing activities.

Consistent with prior research, e.g. Isik and Hassan (2003), Sufian (2009), and Sufian and Noor (2009), TL is positively related to efficiency at 1 per cent level of significance. As expected, the higher lending/financing and investment activities, the higher the efficiency. Bank loans are assumed to be the main source of revenue and are expected to affect performance positively. The market power may be the result of the efficient operations. According to Sufian (2009), the ability to manage the operation more productively would result in decreased production costs and increased market power over inefficient banks. Isik and Hassan (2003) argue that the positive relationship

between loan activity and bank efficiency may be attributed to the ability of the relatively efficient bank to manage operations more productively, which enables them to have lower production costs and consequently to offer more reasonable loan terms. This allows them to gain a larger market share in the loan market segment.

4.3.1 Further analysis: does banking model matter?. In any financial system, the ownership and structure of bank model plays a significant role in shaping the performance of banks. Banks of different models may react in different way for the same determinants. To capture the effects of bank model, similar regression model employed by interacting effects between the determinants and Islamic banks (a dummy variable that takes 1; 0 otherwise). In this model, Islamic bank dummy runs interactively with the determinants of efficiency. As the results of LM test shows that random effects are more appropriate than Pooled OLS in early estimation shown in Table VI, further tests are conducted to choose the appropriate regression based on random or fixed effects (feasible GLS) whichever is appropriate. The Hausman Specification test (Hausman, 1978), which compares a random effect model to its fixed counterpart, is undertaken to specify the appropriatness of each method. The Hausman Specification test suggests that fixed effects outperformed random effects. Therefore, the results of this section are presented and explained based on fixed effects[7]

Table VII presents the results of second stage based on interaction effectts and shows the overall results of the efficiency determinants based on fixed effect estimations. The results for variables remain stable across all models. It can be observed from the baseline model (Table VII) that concentration index ($C3$) has a consistent positive and significant relationship at 1 and 5 per cent across all models. The findings emphasise the importance of concentration effects on the efficiency in the banking industry in Yemen. As discussed previously, concentration tends to weaken competition and increase the collusion among the participants through pricing and investment policies, and this in turn influences corporate performance positively. This is consistent with the theory of SCP (Williams, 2012; Mahathanaseth and Tauer, 2012; Mirzaei *et al.*, 2013). Collusion may result in higher rates being charged on loans and lower interest rates being paid on deposits.

Similarly, the baseline model 1 reveals that when Islamic banks runs a control variable, profitability index (*ROA*) is shown to be consistently associated positively and significantly with efficiency, though the level of significance differs between 5 and 10 per cent. It suggests that banks with high profitability exhibited higher levels of efficiency. A likely reason for this is that banks with higher profitability are able to attract depositors. Besides, the creditworthiness of profitable banks is greater than that of less profitable banks as profitability enhances the confidence of depositors (Sufian and Habibullah, 2010). This creates incentives for banks to be efficient. Surprisingly, after controlling for the dummy Islamic banks, there is a contrary evidence where the profitability is negatively related to efficiency. There are two plausible explanations for unexpected results. One explanation is that Islamic banks are willing to share their efficiency gains with the customers, quite unlike conventional banks, which behave in a profit maximisation manner. The other plausible reason, which relates to marketing strategies, is that the Islamic banks tend to focus on long term objectives, which prompt them to trade off short-term profit for long-term gains. This is evident from the key indicators of Islamic banks that showed that the market share is expanding during the last decade.

Loans/financing (TL/TA) influences efficiency positively and the results are significant at 1 per cent across all models. As discussed previously, bank loans contribute to the

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
LN(GDP)	0.111	0.134	0.107	0.103	0.107	0.106	0.094
	(0.124)	(0.121)	(0.127)	(0.126)	(0.125)	(0.122)	(0.124)
LN(INF)	−0.033	−0.038	−0.031	−0.037	−0.033	−0.020	−0.035
	(0.033)	(0.034)	(0.034)	(0.033)	(0.033)	(0.034)	(0.032)
LN(C3)	0.819	0.771	0.820	0.796	0.823	0.799	0.848
	(0.319)**	(0.308)**	(0.320)**	(0.322)**	(0.317)**	(0.317)**	(0.313)*
Ln(SIZE)	−0.037	−0.094	−0.032	−0.036	−0.033	−0.031	−0.028
	(0.077)	(0.086)	(0.083)	(0.077)	(0.079)	(0.076)	(0.077)
Ln(CAP)	−0.050	−0.059	−0.053	−0.055	−0.048	−0.046	−0.047
	(0.036)	(0.037)	(0.034)	(0.036)	(0.038)	(0.036)	(0.35)
Ln(ROA)	0.165	0.268	0.159	0.201	0.166	0.181	0.179
	(0.087)***	(0.116)**	(0.086)***	(0.092)**	(0.086)***	(0.087)**	(0.087)**
Ln(LLP/TL)	−0.003	−0.009	−0.002	−0.003	0.000	−0.005	0.000
	(0.022)	(0.024)	(0.022)	(0.022)	(0.026)	(0.022)	(0.022)
Ln(NII/TA)	0.061	0.051	0.061	0.061	0.062	0.086	0.058
	(0.054)	(0.054)	(0.055)	(0.055)	(0.055)	(0.065)	(0.054)
Ln(TL/TA)	0.219	0.215	0.220	0.219	0.219	0.218	0.199
	(0.036)*	(0.036)*	(0.035)*	(0.035)*	(0.036)*	(0.036)*	(0.038)*
IB×LnSIZE	–	0.098					
		(0.059)***					
IB×LnCAP			0.030				
			(0.037)				
IB×LnROA				−0.247			
				(0.109)**			
IB×LnLLp/TL					−0.015		
					(0.030)		
IB×LnNII						−0.117	
						(0.074)	
IB×LnTLTA							0.159
							(0.056)*
Overall R^2	0.044	0.114	0.034	0.096	0.053	0.084	0.040
Within R^2	0.127	0.136	0.128	0.131	0.128	0.137	0.137
Between R^2	0.217	0.238	0.197	0.282	0.235	0.24	0.183

Notes: The number in parentheses are the standard errors; Regression Model:

$$EFF = \alpha + \beta 1LN(GDP) + \beta 2Ln(INF) + \beta 3Ln(CON) + \beta 4LN(SIZE) + \beta 5Ln(CAP) + \beta 6Ln(ROA) + \beta 7Ln(CR) + \beta 8Ln(NII) + \beta 9Ln(TLTA) + \beta 10\ Dummy\ Islamic + \varepsilon$$

where GDP is the macroeconomic measure of the soundness of economy; INF measures the price index; C3 refers to the concentration index; size is measured by total assets; CAP is the total equity to total assets; ROA measures the profitability; LLP/TL represents the credit risk; NII/TA measures the non-interest/finance income; TL/TA measures the intensity of loans/finance provided to customers; and finally dummy Islamic is used to differentiate the efficiency of Islamic and conventional banks. *,**,***Significant level at 1, 5, and 10 per cent level, respectively

Table VII. Efficiency determinants based on fixed effects

performance of banks as banks loans provides the main source of revenues. Furthermore, with increasing loans, the market power will allow for banks to produce low-cost products with competitive prices credits terms for borrowers and investors (Sufian, 2009; Isik and Hassan, 2003).

Overall, the coefficient of concentration index ($C3$), profitability (ROA), and loans/finance results resemble that of the baseline model 1, as they keep the same

sign, albeit at different levels of significance. However, it is interesting to note that size of banks becomes significant at 10 per cent when controlling for Islamic banks and this suggests that large size enhances the efficiency of Islamic banks. Similarly, loans/finance relationship remains as in the baseline model 1, though Islamic banks are controlled for. In contrast, the impact of ROA on the efficiency of Islamic banks suggests a negative and significant relationship (at 5 per cent level of significance). This suggests that the efficiency of Islamic banks corresponds negatively to profitability.

5. Conclusion and policy implications

As one of the poorest countries in the Middle East, Yemen and its economy progressed slowly and has yet to achieve its expectations. The banking sector was exposed to several obstacles that impeded the progress of the entire indsutry. This includes the ciruclation of cash out of the monetary system and high non-performing loans among others. The government upon the advice of IMF in an attempt to rectify such problems recommended the introduction of economic reforms which partly focus on the financial system. This has been done in order to improve the productivity and efficiency of the banking sector so as to correspond to international standards. This study provides evidence that banking sector reforms were unsuccessful in attaining the expectations. It is evident that the efficiency scores were very low and there is an urgent need for enahncement and improvement. Taking the results together, Islamic banks were reported to have outperformed their counterparts. Though it is relatively stable, the conventional banks experienced lower levels of efficiency in comparison to Islamic banks. The reforms emarked on by the govement have not born fruit in enhancing the efficiency and fostering comeptition within the banking sector. Necessary steps and policies are needed to further enhance the banking industry. Regulators may embark on new policies to relax foreign entry, with specific emphasis on foreign Islamic banks, which could foster competition and hence efficiency. This calls for further improvements in the informational, contractual and enforcement infrastructure in the country. On the side of managerial efficiency of banks, Islamic bank managers are able to work efficiently, given their roles and constraints imposed on them by Shari'ah norms.

In the second stage, a regression based test is conducted to examine the determinants of efficiency in order to guide the bankers and other authorities on ways to improve the efficiency of banks. The results of regression show that Islamic banks outperfomred conventional banks, though we control for other macro and micro determinants of efficiency. The findings also indicate that banking sector is affected by different influences. However, the behavoir of Islamic and conventionla banks is not same along the way. While both banking models are affected by total loans positively, the behaviour of size and profitability are different for both models. Interestingly and in contrast to conventional banks, the profitability of Islamic banks is negatively related to efficiency. This may indicate that Islamic banks bussines strategy is to forgo some short-term profits for the sake of enhancing long-term profit and sharing the short-run efficieny gains with their customers. Furthermore, given their values, Islamic banks objectives should not be directeed to the profit maximisation only, but other consideration should be taken into account, which could explain the negative relationship. Size of the banks matters only for Islamic banks. Overall such results provide insightful information for the bankers and policy makers to make the necessary measures to enhance the efficiecny of Islamic and conventional banks,

taking into consideration the needs for both banking models to benefit from each other to enhance their efficiency. Future studies could examine deeply other influnces such as institutional environment. Breaking down the efficiency into technical and scale efficiencies yet another extension for this study.

Notes

1. Prior to unification in the 1990s, Yemen had a socialist regime in the south of Yemen and a capitalist regime in the north.
2. Islamic banks refers to banks that abide by Islamic laws, while conventional banks refer to commercial banks that are not involved in Islamic banking products.
3. Appendix 1 shows the detailed efficiency for Commercial Bank of Yemen over years and windows. All other banks detailed results of efficiency are available upon request.
4. Qatar National Bank was the least efficient, however, the comparison made with bank having identical period as Qatar National Bank is newly established.
5. Since the regression model contains dummy variable, which is fixed, it will be perfectly correlated with bank-specific effects. Accordingly, fixed effects cannot be employed, and the random effects is used against the Pooled OLS.
6. According to Hoechle (2009), the Roger standard errors are heteroscedasticity and autocorrelation consistent whenever the panel identifier (e.g. individuals, firms, or countries) is the cluster variable.
7. Pooled OLS and random effects results are shown in the Appendices 2 and 3.

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(The Appendix follows overleaf.)

Appendix 1

Bank	Window		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011		Mean/W	Mean	SD
Commercial Bank of Yemen	1		1.00	0.86	0.73															0.86		
	2			0.87	0.67	0.88														0.80		
	3				0.62	0.84	0.80													0.75		
	4					0.88	0.78	0.78												0.82	0.60	0.16
	5						0.78	0.70	0.66											0.71		
	6							0.61	0.57	0.54										0.58		
	7								0.59	0.53	0.53									0.55		
	8									0.46	0.53	0.54								0.51		
	9										0.53	0.53	0.30							0.45		
	10											0.55	0.29	0.58						0.47		
	11												0.29	0.53	0.52					0.44		
	12													0.56	0.55	0.45				0.52		
	13														0.49	0.40	0.51			0.47		
	14															0.46	0.49	0.41		0.45		
Mean/Year			1.00	0.86	0.67	0.87	0.79	0.70	0.61	0.51	0.53	0.54	0.29	0.56	0.52	0.44	0.50	0.41		0.61		
	Mean Win 1-7																		0.72			
	Mean Win 8-14																		0.47			

Table AI.
Efficiency of Commercial Bank of Yemen (CBY)

Appendix 2

Variable	Model 1	Model 2	Model 3	Model 3	Model 4	Model 5	Model 6
LN(GDP)	0.231	0.205	0.213	0.203	0.211	0.216	0.231
	(0.053)*	(0.051)*	(0.052)*	(0.052)*	(0.052)*	(0.052)*	(0.053)*
LN(INF)	−0.041	−0.040	−0.045	−0.042	−0.042	−0.034	−0.042
	(0.042)	(0.040)	(0.041)	(0.040)	(0.041)	(0.041)	(0.042)
LN(C3)	0.828	0.847	0.861	0.847	0.887	0.838	0.829
	(0.434)***	(0.425)**	(0.429) **	(0.426)**	(0.424)**	(0.425)**	(0.434)***
Ln(SIZE)	−0.170	−0.158	−0.165	−0.153	−0.151	−0.162	−0.170
	(0.028)*	(0.025)*	(0.026)*	(0.025)*	(0.026)*	(0.026)*	(0.028)*
Ln(CAP)	−0.135	−0.152	−0.134	−0.151	−0.147	−0.153	−0.135
	(0.039)*	(0.037)*	(0.038)*	(0.037)*	(0.037)*	(0.037)*	(0.039)*
Ln(ROA)	0.104	0.068	0.065	0.069	0.071	0.066	0.105
	(0.106)	(0.103)	(0.106)	(0.103)	(0.104)	(0.104)	(0.108)
Ln(LLP/TL)	−0.040	−0.022	−0.025	−0.021	−0.006	−0.024	−0.040
	(0.016)**	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)
Ln(NII/TA)	−0.076	−0.084	−0.079	−0.086	−0.084	−0.075	−0.076
	(0.023)*	(0.023)*	(0.023)*	(0.023)*	(0.023)*	(0.024)*	(0.023)*
Ln(TL/TA)	0.153	0.128	0.133	0.129	0.130	0.128	0.153
	(0.029)*	(0.029)*	(0.030)*	(0.029)*	(0.030)*	(0.031)*	(0.029)*
IB×LSIZE		0.016					
		(0.002)*					
IB×LCAP			−0.129*				
			(0.019)				
IB×LROA				−0.124			
				(0.018)*			
IB×LCR					−0.069		
					(0.009)*		
IB×LNII						−0.060	
						(0.009)*	
IB×LTLTA							0.004
							(0.041)
Overall R^2	0.167	0.187	0.210	0.216	0.222	0.210	0.167

Notes: The number in parentheses are the standard errors; Regression Model:

$$EFF = \alpha + \beta 1LN(GDP) + \beta 2INF + \beta 3CONC + \beta 4LN(SIZE) + \beta 5CAP + \beta 6ROA + \beta 7CR + \beta 8NII + \beta 9LN(DEP) + \beta 10\ TLTA + Dummy\ Islamic + \varepsilon$$

where GDP is the macroeconomic measure of the soundness of economy; INF measures the price index; C3 refers to the concentration index; size is measured by total assets; CAP is the total equity to total assets; ROA measures the profitability; LLP/TL represents the credit risk; NII/TA measures the non-interest/finance income; TD/TA represents the total deposits over total assets; TL/TA measures the intensity of loans/finance provided to customers; and finally dummy Islamic is used to differentiate the efficiency of Islamic and conventional banks. *,**,***Significant level at 1, 5, and 10 per cent level, respectively

Table AII. Efficiency Determinants (pooled OLS)