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The sources of productivity change in Yemen Islamic banks: An application of Malmquist productivity index

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Abstract
Motivated by the catalytic role that the banking sector could play in the economy, this paper examined the cost efficiency of Yemen Islamic banks under the intermediation approaches using the Data Envelopment Analysis (DEA) method and panel data for four banks during the period 2002-2014. The most important results on productivity growth on the basis of the intermediation approach that the Total Factor Productivity (TFP) in Yemen Islamic Banks increasing at an annual rate of 2.6% over the study period. In addition, results concerning scale economy, based on non-parametric of the DEA method, suggest that Yemen Islamic Banks have a persistent tendency of operating under conditions of increasing return to scale and that these banks have small sizes and could gain more efficiency by increasing the scale of production. The paper recommended improved of productivity through human capital development, the introduction of new technologies and internet banking services (involving automation and computerization) and, most important, through a credible management chosen on the basis of competence and expertise.

Keywords: Yemen ISLAMIC Banks, Malmquist productivity index

1. Introduction
The main framework of an Islamic financial system is shaped by rules and laws which are economic, social, political and cultural taboos for Islamic societies (Musa and Obadi, 2009) [23]. The Islamic banking industry of the world has been growing consistently since the mid-1970s when it was first established. It claims to be an important aspect of the global finance market today (Mallin *et al*., 2014) [20]. The working principle behind Islamic banks is based on the profit and loss sharing (Bellalah and Ellouz, 2004) [6]. Islamic banking naturally has flourished in countries with concentrated Muslim populations. However, countries with no significant Muslim population (i.e. England) have been conducting Islamic banking operations in the Middle- East.

Islamic banks have been making efforts to increase their productivity in order to improve their performance as a result of the globalization and increased competition (Mghaieth and Mehdi, 2014) [21]. The recent global mortgage crisis brought Islamic finance forward as an alternative in terms of investment and banking (Smolo and Mirakhor, 2010) [30]. Islamic banking has become an integral part of the global finance structure particularly with its immunity to the recent banking and financial crises (Aldohni, 2015) [2]. Islamic banking has gained momentum and acknowledgment especially in the Middle-East and Southern Asia when compared to the rest of the world (Ariff, 2014) [3]. The most important reason behind this is that these parts of the world are home to countries with a majority of Muslim population.

According to economists, Yemen's financial services sector is underdeveloped and dominated by the Banking system. Yemen has no public stock exchange. The Banking system consists of the Central Bank of Yemen, 16 commercial Banks (nine private domestic Banks, four of which are Islamic Banks; four private foreign Banks; and two state-owned Banks), and two specialized state-owned development Banks. The Central Bank of Yemen controls monetary policy and oversees the transfer of currencies abroad. It is the lender of last resort, exercises supervisory authority over commercial Banks, and serves as a Banker to the government. Since end 2005 and up to the end of 2010.

This paper deal with measurement of how performance changes over time in Yemen Islamic Banks, The emphasis was to measure change in productivity over time, the particular measure of productivity used was based on distance functions, namely a Malmquist (input-based) productivity index (Färe *et al*., 1992) [14]. Productivity was estimated and decomposed into two separate effects using the mathematical programming procedures (Färe *et al*., 1990) [16] and (Hjalmarsson and Veiderpass, 1992) [17]. These effects represent the catching up of separate firms with the benchmark production frontier and the shift of frontier over time, (Price and Weyman-Jones, 1996) [25].

The basic used here was what is typically called productivity or productivity growth; in fact, they were the natural building blocks for measuring Total Factor Productivity (TFP). It was noted that improvements in productivity would result in values of input based Malmquist index (M_i) to be less than one. Values of greater than one signified deterioration in productivity. The same interpretation applied to the efficiency change and technical change component. Note, however, that improvement in productivity could be accompanied by deterioration in one of component. Value of one reflected no change in performance.

Linear programming techniques were employed to construct the Malmquist productivity index for two cotton cultivars. The advance of this approach was that the index allowed the decomposition of change in total factor productivity into change in technical efficiency, change in pure efficiency, change in scale efficiency and technological change. Therefore, improvement in total factor productivity could occur as result of either improvement in technical efficiency (moving closer to the production frontier) or improvements in technology (outward shift of the production frontier).

One issue that must be stressed was that the returns to scale properties of the technology were very important in (TFP) measurement (Coelli, 1996; Coelli and Rao, 2005; Bushara and Mohayidin, 2007) [8, 10, 7] proved that a Malmquist TFP index might not correctly measure TFP change when Variable Return to Scale (VRS) was assumed for technology. Hence, it was important that Constant Return to Scale (CRS) be imposed upon any technology that might use to estimate distance function for the calculation of a Malmquist TFP index.

1.2 Problem statement

The problem of this study is to assess the possibility of raising the efficiency of Yemen Islamic Banks to increase their productivity, given the limited resources opportunities for technology development and transfer by measuring efficiency and productivity and separating their effects from technology and production environment, the source of efficiency and productivity differential could be explored. Estimates on the extent of the inefficiency could help decide whether to improve efficiency or to develop new technologies to increase Yemen Islamic Banks productivity. Identification of sources is essential to the institution of public and private policies designed to improve micro and macro performance.

1.3 Objectives of the study

The main objective of the study is to examine how changes which occurred in the financial services sector during the 13-year period (2002-2014), affected the productivity of the Islamic Banking industry in Yemen. Furthermore, this paper was aimed at achieving the following specific objectives:

(1) To review and evaluate the performance of Yemen Islamic Banks productivity over time. (2) To decompose total factor productivity change into efficiency change and technology change. (3) To identify the critical parameters that affect improvement of the total factor productivity.

2. Overview of literature

Institutions offering Islamic financial services constitute a significant and growing share of the financial system in the world. Since the inception of Islamic banking about three decades ago, the number and reach of Islamic financial institutions worldwide has risen from one institution in one country in 1975 to over 300 institutions operating in more than 75 countries. Islamic banks are concentrated in the Middle East and Southeast Asia, but they are also present as niche players in Europe and the United States. Reflecting the increased role of Islamic finance, the literature on Islamic banking has grown. A large part of the literature contains comparisons of instruments used in Islamic and commercial banking and discusses the regulatory and supervisory challenges related to Islamic banking. Several studies in recent years focused on the efficiency analysis of Islamic banks using simple and advanced methodologies and testing several interesting hypotheses (Onour and Abdalla, 2011; Said, 2013; Rosman *et al*., 2014; Wanke *et al*., 2016) [24, 27, 26, 31]. Empirical works dealing with productivity are very rare. Literature on existing studies can be classified into two groups. The first group of studies includes performance assessment and determinants of Islamic banks, whereas the second group of studies includes the comparative analysis of performance level between Islamic and conventional banking sectors.

(El Moussawi and Obeid, 2011) [13] used Data Envelopment Analysis (DEA) model to decompose the productive efficiency into technical efficiency, allocation efficiency, and cost efficiency of Islamic banks. They found an increase of production efficiency of the Islamic banks over the study period.

(Assaf *et al*., 2011) [4] analysis technical efficiency of Saudi banks using two-stage DEA approach, following intermediation approach. Saudi banks improved their efficiency since 2004. Following intermediation approach, (Bahrini, 2015) [5] used the bootstrapped Malmquist index to a sample of Islamic banks operating in 10 MENA countries. He found a decrease in productivity, technical efficiency and technological efficiency. However, scale efficiency found to be a source of productivity amelioration.

(Johnes *et al*., 2014) [18] decompose Malmquist index into technical efficiency change and technological change to detect productivity variation source in Islamic banks. Following intermediation approach, they found positive technical efficiency change and negative technology change, which are allowed to differ between groups of banks.

(Ahmad *et al*., 2010) [1] (Ahmad *et al*., 2010) [1] calculated efficiency measures of individual Islamic banks of Asian countries over the period 2001-2006. The calculations based on DEA revealed that in 2004, the Islamic banks showed highest mean technical efficiency of 86.5%. The pure technical inefficiency of Asian Islamic banks was more than scale inefficiency.

(Onour and Abdalla, 2011) [24] worked on estimating efficiency measures and productivity changes of Islamic

banks in Sudan. Analysis was made using data envelopment analysis conducted on the sample of 12 Islamic banks. The results found only two largest Islamic banks overall technically efficient; on the other hand, only one Islamic bank (smallest Islamic banks of Sudan) secured pure technical efficiency but the same bank was scale inefficient. Thus the size of banks was found as key factor for scale efficiency rather than ownership.

(Kamaruddin *et al*., 2008) [19] used intermediation approach to assess performance of banks. They found that Islamic banks are more efficient than conventional banks. (Mobarek and Kalonov, 2014) [22] investigate the performance of Islamic banks versus conventional banks around the recent financial crisis. Their major finding was that overall Islamic banks are less efficient than Conventional banks and this superiority varies depending on bank size and the impact of recent crisis is not visible on both banking sectors.

From a review of studies, it is obvious, that literature suffers from the lack of empirical research focused on productivity analysis and sources of productivity in Islamic banking sector. Moreover, several studies that have been devoted to assess the performance of Islamic banks generally examine the productivity following either the intermediation approach or the production approach. The intermediation approach is the common used approach to assess performance of Islamic banks. In summary, numbers of studies have shown that Islamic banks demonstrate performance and there is still no evidence of the effect of Subprime crisis on Islamic banks productivity. Therewith, there is no evidence of sources of productivity variation in literature. This paper attempts to fill the gap in the empirical literature in this area by providing an empirical analysis of productivity measurement using the total factor productivity Malmquist index and its decomposition into technological change, scale change and technical efficiency change components. The estimation method is nonparametric relying on DEA. To model, an Islamic bank two approaches may be followed: intermediation approach and production approach. The basic difference between these two approaches is that in intermediation approach deposits are treated as input whereas it has output status in production approach. In this paper, adopted intermediation approach for estimating productivity of Yemen Islamic banks using DEA. Furthermore, this paper the evolution of technical efficiency under variable returns to scale and scale returns to scale.

3. Methodology and Data

3.1 Methodology

This paper applies Malmquist productivity index to measure cost efficiency of four Yemen Islamic banks, Tadhamon Islamic Bank (TIB), Yemen Islamic Bank (YIB), Saba Islamic Bank (SIB), and Al-Shamel Yemen Bahrain Bank (SBB). The Malmquist productivity index (MPI) evaluates the productivity change of decision-making units between two time periods. It can be defined as the product of Catch-up and Frontier-shift terms. Catch-up or recovery is related to the degree in which a decision-making unit (DMU) improves or worsens efficiency frontier shift (or innovation) is a term which reflects the change in the efficiency its frontiers between the two time periods(Cooper *et al*., 2007) [11].

As discussed above the Malmquist index measures productivity growth (change). An MPI productivity change could be due to either change in technical efficiency or change in the technology – technological progress in the industry. The total factor productivity change is the product of technical efficiency change and technological change. Technical efficiency change is decomposed into pure technical efficiency and scale efficiency change.

The Malmquist index measures Total Factor Productivity (TFP) change between two data points by calculating the ratio of the distances of each data point relative to a common technology and it requires the inputs and outputs from one time period to be mixed with the technology of another time period. Following (Fare *et al*, 1994) [15], this study adopted the input-oriented Malmquist productivity change index, referring the emphasis on the equi-proportionate increase of inputs, within the context of a given level of outputs. The input-oriented Malmquist productivity change index could be expressed as follows:

$$\mathbf{M}_i\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1},\mathbf{x}^t,\mathbf{y}^t\right)=\left(\frac{\mathbf{D}_i^{t+1}\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1}\right)}{\mathbf{D}_i^t\left(\mathbf{x}^t,\mathbf{y}^t\right)}\right)\left[\left(\frac{\mathbf{D}_i^t\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1}\right)}{\mathbf{D}_i^{t+1}\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1}\right)}\right)\left(\frac{\mathbf{D}_i^t\left(\mathbf{x}^t,\mathbf{y}^t\right)}{\mathbf{D}_i^{t+1}\left(\mathbf{x}^t,\mathbf{y}^t\right)}\right)\right]^{1/2} \quad \text{..... (1)}$$

Where the quotient outside the brackets measured the change in technical efficiency and the ratios inside the brackets measured the shift in the frontier between period's t and t +1. The technical efficiency could be further; decomposed to become:

$$\mathbf{M}_i\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1},\mathbf{x}^t,\mathbf{y}^t\right)= \text{PEFCH * SEFCH * TECH ..... (2)}$$

In which TECH represent technical change, PEFCH represent pure efficiency change, and SEFCH represent scale efficiency change. The scale change and pure efficiency change components were decompositions of efficiency change calculated relative to constant returns to scale: EFCH=PEFCH* SEFCH. EFCH referred to efficiency change calculated under constant returns to scale, and PEFCH is efficiency change calculated under variable returns to scale. To derive the full decomposition, including the scale-change component, calculation of two additional programming problems are required, these are $\mathbf{D}_i^t\left(\mathbf{x}^t,\mathbf{y}^t\right)$ and $\mathbf{D}_i^{t+1}\left(\mathbf{x}^{t+1},\mathbf{y}^{t+1}\right)$ relative to the technology of variable return to scale (Fare *et al*., 1994; Coelli, 1996; Bushara and Mohayidin, 2007) [15, 8, 7].

The linear programming method has two advantages over parametric stochastic techniques in measuring productivity change in productivity change (Fare and Primont, 2012). When parametric techniques were used, the choice of functional form for specifying the technology and the choice of the error structure both influenced the degree of efficiency (Coelli, 1996) [8]. Linear programming techniques enveloped the data without the specification of a restrictive functional form and were free from distribution bias. The methodology allowed the recovery of various efficiency and productivity measures in a commendable calculable manner. Specifically, it was able to answer questions related to technical efficiency, scale efficiency and productivity changes.

The input distance function of (Färe *et al*., 1992; Fare *et al*., 1994; Bushara and Mohayidin, 2007) [14, 15, 7] was employed to construct the various measures of productivity efficiency of Yemen Islamic Banks.

Productivity growth was estimated and decomposed into separate effects using the mathematical programming procedures of (Färe *et al*., 1990; Hjalmarsson and Veiderpass, 1992) [16, 17]. These effects represented:

1- The catching-up of separate firms with the industry production frontier and 2- The shift of the frontier over time and panel time (Price and Weyman-Jones, 1996) [25]. To estimate the distance function defined by equation (1), a non-parametric linear programming technique was employed (Fare *et al*., 1994) [15] (Fare *et al*., 1994) [15]. This technique was automated in DEAP software Version 2.1 described in (Coelli, 1996) [8].

Equation (2) was estimated to decompose technical efficiency into pure technical efficiency and scale efficiency. Note that efficiency scores in this study were estimated using the same technique. The technique served to envelop the data and define the best-practice reference technology, without imposing a restrictive functional form. The productivity index may be expressed in terms of the following distances along the x-axis as

$$M_i\,(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{\left(\frac{ob}{oa}\right)}{\left(\frac{od}{oe}\right)}\left[\left(\frac{oa}{oc}\right)\left(\frac{of}{oe}\right)\right]^{1/2} \quad \ldots (3)$$

Where (0b/0a)/ (od/oe) denotes the ratio of the Farrell measures of technical efficiency and the last part is the geometric mean of the shifts in technology at y^t and y^{t+1}. It is to be noted that the shifts in technology are to be measured locally for the observation at t and t+1. This implies that: the whole technology need not behave uniformly and the technological regress is possible**.**

Scale inefficiency change would not indicate whether the change was due to operation of the decision making unit (DMUs) at increasing returns to scale (IRS) or at decreasing returns to scale (DRS) or at constant return to scale (CRS) To know this technical efficiency for the *ith* DMU, the estimated input-orientated efficiency score under constant returns to scale is given by solving the following linear programming model:

$$\min_{\lambda,\hat{\theta}_i} \hat{\theta}_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\textbf{\textit{Subject to}} \quad -y_i + Y\lambda \geq 0$$

$$\hat{\theta}_i\, x_i - x\,\lambda \geq 0$$

$$\boldsymbol{\lambda \geq 0}$$

Where X and Y are matrices of the inputs and outputs, respectively, of all observed (N) DMUs; x_i and y_i are, respectively, the input and output vectors of the ith DMU; λ is N 1 vector of constants; $\hat{\theta}_i$ is the technical efficiency of the ith DMU, bounded by 0 and 1,with a value of 1 indicating a technically efficient DMU.

The VRS DEA model is obtained by adding the constraint N1′λ =1, where N1 is an N x 1 vector of ones. This is a convexity constraint ensuring that a firm is benchmarked against firms of a similar size. Scale efficiency is obtained as the ratio of the CRS efficiency measure (technical efficiency) to the VRS measure (pure technical efficiency). DEA under decreasing returns to scale (DRS) is obtained by adding the constraint N1′λ = 1. If the two scores are different, then the ith DMU operates under increasing returns to scale (IRS), (Simar and Wilson, 2000) [29].

3.2 Data

The table (1) describes the variables adopted in this study. For the definition of inputs and outputs, this paper followed the intermediation approach proposed by(Sealey and Lindley, 1977). Three outputs are specified, total loans, other earning assets, and non-interest income. Financial capital, physical capital and Labor are the inputs. The treatment of equity is relatively standard in banking efficiency estimation. It captures the level of capitalization, insolvency risk and different risk preferences across banks. (Delis and Papanikolaou, 2009) [12].

Table 1: Variable definitions and notation

Variables	Definition
Outputs variables 1- Total loans	Which include (Murabaha, Qard Hasan, and Istisna).
2- Earning assets	Are comprised of due from banks and financial institutions, restricted investment, investment in Islamic sukuk, available for sale investment, investment in associates.
3- Non-interest income	Are comprised of net fees and commissions, gains on foreign exchange transactions, gains on investment and other operating income.
Input variables 1- Total deposits	which include short and long term deposits, short and long term saving deposits, deposits from the central bank, deposits from commercial banks and other depository institutions, inter-bank funds purchased, securities sold under agreement of repurchase, government deposits, and short and long term bonds.
2- Total physical capital	Is the book value of total fixed assets less the book value of accumulated depreciation.
3- labor	Is proxy by the total wage of employees.

Table (2) below reports some descriptive statistics of the data on time varying outputs and inputs for sampled Banks over the study period. It shows each variable mean, maximum (max), minimum (min), and standard deviation (SD). It is observed that each variables shows fluctuations between increasing and decreasing except total wage shows increase from an average of YR 171 million in 2002 to an average of YR 1464 million in 2014 with average annual rate of growth of 0.63%. While total loans increased from an average of YR 10,031 million in 2002 to an average of YR 33,772 million in 2014 with average annual rate of growth of 0.20%. Also, earning assets exhibited a similar trend; it increased on an average of YR 9,600 million in 2002 to an average of YR 128,311 million in 2014 with average annual rate of growth of 1.03%. While non- interest income have increased from YR 1,130 million in 2002 to YR 5,574 million in 2014 with average annual rate of growth of 0.33%. The total deposits increased from an average of YR 19,915 million in 2002 to an average of YR 163,129 million during the study period with average annual rate of growth of 0.60%. And fixed assets increased from an average of YR 379 in 2002 to an average of YR 2,777 million during the study period with average annual rate of growth of 0.53%. In addition. The standard deviations of all other variables also have increased (with few exception) during the sample period. Monetary Unit=1 million.

Table 2: Descriptive Statistics of Outputs and Inputs of the Sample Banks, (2002-2014) Monetary Unit=1million YR

Years		Loan	Earning assets	Non-interest income	Deposits	Fixed assets	Labor
	Mean	10031	9600	1130	19916	380	172
2002	Max	30118	21973	2435	50425	548	249
	Min	4335	3052	286	4589	180	122
	SD	13572	8544	917	20696	164	59
	Mean	12848	12442	1085	29587	514	192
2003	Max	36559	26477	1748	72248	900	288
	Min	1643	3656	390	7374	174	81
	SD	15988	10468	566	29260	322	87
	Mean	18813	15343	1264	39874	831	220
2004	Max	53630	30333	2141	96445	2157	316
	Min	2936	4746	419	8326	167	84
	SD	23479	12541	711	39576	911	102
	Mean	20081	19970	1891	52061	1015	273
2005	Max	47011	49187	3214	121908	2423	393
	Min	5274	3033	846	13637	214	107
	SD	19332	21163	1042	49526	1028	122
	Mean	23712	31045	2566	66911	1069	325
2006	Max	65309	76008	5753	166029	2591	516
	Min	4795	3202	700	13015	213	137
	SD	28439	32999	2379	68959	1122	157
	Mean	30988	37924	2837	78087	1346	431
2007	Max	86468	87915	6545	199670	3211	746
	Min	6905	2063	801	11840	208	194
	SD	37629	41370	2716	88604	1346	235
	Mean	30337	59625	3867	94998	1824	590
2008	Max	79904	147903	10529	239043	544	1042
	Min	7053	4097	257	12954	171	226
	SD	34038	67836	4649	106816	2478	359
	Mean	30829	79200	5943	114046	1950	805
2009	Max	76117	205407	14970	282950	5598	1644
	Min	7789	4249	946	12609	159	298
	SD	31582	92883	6408	125585	2516	640
	Mean	32643	84701	5690	128608	1881	939
2010	Max	83758	224908	11549	323369	4998	1880
	Min	7275	5131	532	13441	131	328
	SD	35207	102880	5192	145068	2197	726
	Mean	21804	89628	6347	112640	1994	1055
2011	Max	51269	247538	16776	284208	4802	2174
	Min	6946	5246	328	12068	133	318
	SD	20772	112680	7438	126055	2030	863
	Mean	31361	124047	5341	140280	1810	1348
2012	Max	87276	347659	12767	375662	3895	2942
	Min	6000	5594	367	13782	188	374
	SD	38233	158444	5488	165004	1623	1203
2013	Mean	26368	133639	6756	170415	2695	1403
	Max	52388	360516	18103	451511	5988	2911
	Min	6676	6442	299	15475	194	379
	SD	22300	163010	7997	199099	2573	1179
	Mean	33773	128311	5575	163130	2777	1464
2014	Max	76298	374218	9995	452412	5822	2862
	Min	8823	6493	208	16461	204	399
	SD	32159	169133	5011	199836	2547	1157

4. Results and Discussion

4.1 Change in Productivity of Individual Banks

Table (3) reports the results of the Malmquist Performance Index for the average Bank over the period 2002-2014 under the intermediation approach. All indices are calculated relative to the previous year. With 2002 taken as the base year, it were obtained indices for the period 2003-2014.

Table (3) reports the results on the productivity change and total factor productivity. From the results in total factor productivity (tfpch) change column, it was observed that over the period under consideration average total factor productivity increased at an annual average rate of 2.6%. According to these results, Yemen Islamic Banks have achieved productivity growth of 2% in 2005, 10% in 2006, 12.3% in 2007, 35.3% in 2009, 9.8% in 2011, 7.5% in 2012, and 16% in 2013 while they have registered productivity decline in 2003, 2004, 2007, 2010, and 2014. Following (Coelli, 1998) [9], productivity changes reflect the product of changes in technical efficiency and technology. According to these findings, Islamic Banks in Yemen have been able to achieve such productivity improvement from becoming more technical efficiency (average teffch was 3.4%). While results indicate that technological efficiency (techch) declined at average annual rate of -0.9%. These results

suggest that the technical efficiency (teffch) was more attributable to the total factor productivity change (tfpch) than to technological efficiency change (techch). It is observed that technical efficiency (teffch) varied during the study period from low rate of -24.4% in 2014 to a high rate of 20.7% in 2008, while technological efficiency change (techch) varied from low rate of -27.4% in 2005 to a high rate 12.7% in 2007 Table (3).

Table 3: Mean Malmquist Efficiency and Total Factor Productivity Change in Yemen Islamic Banks, 2002-2014.

Year	teffch	techch	pech	sech	tfpch
2003	0.961	1.242	0.961	0.999	1.193
2004	1.023	1.167	1.023	1.001	1.194
2005	1.123	0.873	1.123	1.000	0.980
2006	0.920	0.973	0.986	0.933	0.896
2007	0.953	1.274	0.889	1.072	1.215
2008	0.793	1.105	1.115	0.712	0.877
2009	1.112	0.582	0.988	1.114	0.647
2010	0.837	1.211	0.898	0.932	1.013
2011	0.845	1.068	1.141	0.741	0.902
2012	1.037	0.892	0.958	1.083	0.925
2013	0.847	0.992	1.044	0.811	0.840
2014	1.244	0.961	1.000	1.244	1.195
Mean	0.966	1.009	1.008	0.958	0.974

Source: Author own calculations based on data.

The Table (3) also reports the results on the two components of the efficiency change, namely the change in pure technical efficiency (pech), which measures performance due to managerial activity only and the change in scale efficiency (sech). According to these results, the average Bank recorded an increase in scale efficiency over the study period, except for 2004, 2007, 2009, 2012, and 2014 when scale efficiency declined at annual rate of 0.1%, 7.2%, 11.4%, 8.3% and 24.4%, respectively. Scale efficiency increased at an annual average rate of 4.2% over the period, increasing from a low rate of -24.4% in 2014 to a high rate of 28.8% in 2008. Pure technical efficiency fluctuated over the period, registering an annual average rate of decline of 0.8%. When it increased at the rate of 3.9% in 2003, 1.4% in 2006, 11.1% in 2007, 1.2% in 2009, 10.2% in 2010, and 4.2% in 2012. These results suggest that the observed growth in technical efficiency may be attributed to growth in managerial efficiency (pech) less than to growth in scale efficiency.

From the results in Table (4), it is observed that the total factor productivity increased for two out of four Banks while it decreased for two Banks, namely Saba Islamic Bank (SIB), and Yemen Islamic Bank (YIB). The tfpch varies from a low rate of -10.6% for (YIB) to a high rate of 11.7% for Al-Shamel Yemen Bahrain Bank (SBB). For the two components of productivity growth, the results suggest that technical efficiency (teffch) Constant for one Bank (Yemen Islamic Bank (YIB)), increased for three Banks. It varied between a high rates of 9.2% for Tadhamon Islamic Bank (TIB). On the other hands, technological efficiency (techch) decline for three Banks and increased for one Bank (Al-Shamel Yemen Bahrain Bank (SBB)). It varied between a high rates of 9.4% for (SBB) to a low rate of -10.6% for (YIB). (Details in appendix 1a).

For the two components of technical efficiency change, namely the change in pure technical efficiency (pech) and the change in scale efficiency (sech), the results show that pure technical efficiency declined only one Bank and remained constant for three Banks. Saba Islamic Bank (SIB) registered the lowest pech (-3.3%). Scale efficiency increased for three Banks and remained constant for one Bank. (TIB) registered the highest sech (9.2%).

Table 4: Mean Malmquist Efficiency and Total Factor Productivity Change for Individual Banks, 2002-2014.

Bank	teffch	techch	pech	sech	tfpch
Tadhamon	0.908	1.011	1.000	0.908	0.918
Islamic	1.000	1.106	1.000	1.000	1.106
Saba	0.983	1.022	1.033	0.952	1.005
Shamel	0.975	0.906	1.000	0.975	0.883
Mean	0.966	1.009	1.008	0.958	0.974

Appendix 1a: Total Factor Productivity Change of Islamic Banks in Yemen (2002-2014).

Bank Years	Tadamon TFP	Islami TFP	Saba TFP	Shamil TFP	Mean
2003	1.248	1.349	1.028	1.171	1.193
2004	1.182	1.030	1.272	1.314	1.194
2005	0.626	1.558	1.207	0.784	0.980
2006	0.869	1.122	0.715	0.923	0.896
2007	1.149	1.511	1.006	1.247	1.215
2008	0.700	1.161	0.950	0.764	0.877
2009	0.728	0.509	0.782	0.604	0.647
2010	1.234	1.165	0.764	0.960	1.013
2011	0.661	1.223	0.921	0.889	0.902
2012	1.288	0.897	1.127	0.563	0.925
2013	0.499	1.068	1.179	0.790	0.840
2014	1.454	1.128	1.344	0.926	1.195
mean	0.918	1.106	1.005	0.883	0.974

5. Conclusion

Based on the intermediation approach, it is observed that over the study period, total factor productivity increasing at an annual average rate of 2.6%. According to this results, Islamic Banks in Yemen have been able to achieve such productivity improvement from becoming more technical efficiency (average teffch is 3.4%). While results indicate that technological efficiency (techch) declined at average annual rate of -0.9%. These results suggest that the technical efficiency (teffch) was more attributable to the total factor productivity change (tfpch) than to technological efficiency change (techch).

Also reported results based on intermediation approach, it's observed two components of technical efficiency change, namely the change in pure technical efficiency (pech) and the change in scale efficiency (sech), the results show that pure technical efficiency declined only for one Bank and remained constant for three Banks. Saba Islamic Bank (SIB) registered the lowest pech (-3.3%). Scale efficiency increased for three Banks and remained constant for one Bank. (TIB) registered the highest sech (9.2%).

In addition, it is observed that Banks operating under increasing returns to scale represent about 75% of the total while those operating under constant returns to scale represent only about 25% of the total (Table 4). These results suggest that the Islamic Banking industry in Yemen is dominated by relatively small sized Banks and that most of these of Banks are operating on the downward segment of their cost curves. Such a reading suggests the presence of technical and pure technical efficiency problems in the Islamic Banking industry.

The results under intermediation approach in each method indicate over the study period that total factor productivity

in Yemen Islamic Banks was improved. Most Yemen Islamic Banks operate at the wrong scale, with a large majority operating under increasing returns to scale (SSB, YIB and SIB). This means that substantial could be gained from altering scale via internal growth.

The overall study findings suggest that policy reforms on their own may not be enough to improve the productivity gains of the Banking industry. The introduction of financial reforms may affect productivity gains if individual Banks are able to capture the opportunities created by such reforms and if the government is able to attain and sustain microeconomic stability in the country.

6. Reference

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