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Total factor productivity change of MENA microfinance institutions: A Malmquist productivity index approach

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ABSTRACT

The main purpose of this paper is to investigate productivity changes of 33 Middle East and North Africa microfinance institutions over the period of 2006–2011 by using the Malmquist productivity index (MPI) method and a balanced panel dataset of 198 observations. The empirical findings indicate that the microfinance industry has reported overall productivity regress in the study period even though all the MENA MFIs have positive TFP growth with the exception of the year 2010–2011. In addition, our study indicates that over the period the Malmquist productivity change experienced by the MENA microfinance industry as a whole has averaged 4.9% annually which was mainly attributed to technical efficiency change. The study reveals also that the industry as a whole has exhibited a decline in technological change (2.9% decrease over the period) and suggested that there has been a deterioration in the performance of the best practicing MFIs. By decomposing the Malmquist index, the result showed that during the study period the MENA MFIs have experienced mainly an increment of pure technical efficiency (improvement in management practices) rather than an improvement in optimum size. Overall, an essential strategic implication for the MENA microfinance industry is that they need to pursue a technological progress in order to meet the dual objectives of reaching many poor people and financial sustainability.

1. Introduction

Microfinance institutions (MFIs) are vital ingredients in the development processes of a country. They provide a variety of financial services to the world's lowest-income households especially in developing countries. Since their inception in the early 1980s, MFIs have been driven fundamentally by a social mission of enhancing outreach to alleviate poverty. Recently, however, there seems to be a major shift in emphasis from the social objective of poverty alleviation towards the economic objective of sustainable and market based financial services.

Various MFIs focus on providing small-scale financial services mostly credit to poor and under-served on a sustainable basis, that is, to lend very small loans, or micro-loans, to very poor people. The sustainability of MFIs seems then to be a primary issue for successful microfinance services. Closely looking, MFIs are challenged to meet a "double bottom line" of outreach (providing financial services to the poor) and sustainability (covering their costs). In the same vein, Otero (1998) argues that MFIs need to generate profit, but at the same time, they are required to balance the social objectives of reaching low-income entrepreneurs with generating a return for their investors.

For many years the MFI industry was operating with subsidy from donors and governments but more recently there has been increasing internal and external pressure for the MFIs to find a way to reduce their dependence on subsidies or grant funding to become financially sustainable. Nevertheless, serving the poor and being financially self sufficient seem contradictory. An extensive examination of the challenges that MFIs are facing currently, there seems to be a need in dynamism that improves costs effectiveness and productivity performances. Therefore, efficient operations of the microfinance industry are essential for the well functioning of MFIs in the long run in achieving the dual objectives (outreach to the poor and financial sustainability). In this framework, studies aiming at investigating efficiency and productivity of these institutions have become appealing in an effort to improve their outreach performances, remain competitive and become sustainable.

Over the last decade, there has been a considerable amount of research performed to study the performance and efficiency of MFIs such as Abdul Qayyum and Ahmad (2006), Gutiérrez-Nieto et al. (2007), Ben Soltane (2008), Hermes et al. (2008), Haq et al. (2010), and Islam et al. (2011). However, to the best of our knowledge, few researches have been performed so far to investigate the productivity change of MFIs (Gebremichael and Rani, 2012; Krishnasamy et al., 2004; Sufian, 2007). Therefore, in this study, an attempt is being made

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Table 1
Descriptive statistics of variables (inputs and outputs).

			2006	2007	2008	2009	2010	2011
Input	Operating expenses	Average	338,073.07	456,196.20	661,512.40	839,407.10	1,116,844.00	1,485,978.04
		Std dev	483,416.053	677,295.702	890,280.763	1,188,215.847	1,799,420.306	2,725,021.25
		Max	1,865,700	2,687,450	3,216,371	4,336,629	7,394,112	12,607,233
		Min	25,894	34,499	51,585	63,465	72,290	82,342
	Number of employees	Average	217	269	294	311	325	339
		Std dev	342	436	416	427	430	433
		Max	1843	2373	2073	2133	2124	2115
		Min	16	17	20	21	24	27
Output	Gross loan portfolio	Average	15,484,694.3	22,777,269.27	26,343,972.94	28,629,276.73	30,620,002	32,749,151
		Std dev	38,493,776.57	55,394,023.32	59,942,193.81	61,466,545.3	55,914,822.99	50,864,538
		Max	219,106,022	304,829,793	333,623,362	347,610,216	295,347,932	250,943,145
		Min	222,866	171,994	274,371	294,079	583,685	1,158,492
	Number of loans	Average	1,088,873.05	68,101.30	81,526.45	98,452.95	108,202.85	118,918.293
		Std dev	3,560,694.682	130,002.942	145,643.921	170,817.514	189,609.428	210,468.671
		Max	15,622,650	434,814	536,804	597,723	108,202.85	19,587.4289
		Min	1153	1365	1917	1924	2984	4627
	Interest & fee income	Average	766,112.75	1,176,197.55	1,784,483.84	1,784,483.84	3,168,793.15	5,626,977.28
		Std dev	1,531,603.59	2,394,933.57	3,333,634.44	4,602,177.50	6,408,038.59	8,922,506.48
		Max	5,458,600	8,022,074	11,671,356	16,947,735	25,368,310	37,972,693
		Min	18,806	32,860	38,236	74,535	101,127	137,206

Source: Author's computation

to investigate the productivity change of Middle East and North Africa (MENA) MFIs during the period 2006–2011 using Malmquist index. The importance to investigate the efficiency and productivity of MENA MFIs could be best justified by the fact that in MENA, the MFIs played an important role in complementing the services offered by the commercial banks. The existence of MFIs supported by efficient money and capital markets keeps the financial sector complete and enhances the overall economic efficiency and growth. Moreover, it is expected from this study to show managers, practitioners and policy makers the performance of MENA MFIs and thereby contribute to the lack of literature in areas of microfinance.

The remainder of this paper is scheduled as follows. Section 2 briefly presents MENA's microfinance industry. Section 3 puts brief review of empirical studies on efficiency and performance of MFIs in the world. Section 4 sets out data and methodology including input and output specifications we have used. The results are presented and discussed in Section 5. Finally, section 6 surveys the paper and gives suggestions for future research and managerial implications.

2. Overview of MENA's microfinance industry

Over the last few decades, microfinance has proven itself to be a useful tool to foster financial and economic development in low income countries. Microfinance, the provision of financial services to the poor, allows micro and small entrepreneurs to develop their businesses, build household income and economic security, reduce vulnerability, and improve overall standard of living.

In the Middle East North Africa region, the microfinance sector is relatively young and is gradually developing through a variety of MFIs, dominated by NGO[1] and government programs. The extent to which microfinance operates in MENA varies considerably across the region: Morocco, Egypt and Jordan are described as being the most developed markets, with Egypt and Morocco receiving almost 77% of microfinance funding for the whole region. Emerging markets are Yemen, Syria and Tunisia, whereas other countries, such as Algeria and Libya, have barely any activity, very low market penetration and little MFI activity.

[1] Non Governmental Organization

Looking at microfinance in the MENA region, one gets a rather ambiguous picture. On the one side, the sector is characterized by high returns, good portfolio quality, and continuous growth. On the other side, leverage is amongst the lowest of the world. This emphasizes the issue that currently only two countries of the region (Yemen, Syria) have MFIs that are allowed to offer savings. Also, other products, like payments or microinsurance schemes are in a nascent stage with innovation taking up only slowly in this region. Furthermore, despite recent developments, the microfinance landscape is still largely dominated by NGOs. While having experienced an impressive development in the past, by their pure nature, they face limitations when it comes to further growth as well as product diversification.

As per Microfinance International Exchange (MIX) data, the emerging industry has expanded tremendously since its commencement as there are today approximately 85 active MFIs across the MENA region. Based on a sample of 10 countries (Egypt, Iraq, Jordan, Lebanon, Morocco, Palestine, Sudan, Syria, Tunisia, Yemen), the MENA region has barely 2.2 million active borrowers (with outstanding loans) for a global loan portfolio of 1.2 billion USD. As of 2011 the industry has pulled a total asset of 1.4 billion USD and mobilized a total deposit of 49.1 million USD.

However, despite these achievements remains a great challenge to microfinance industry in the MENA region. For microfinance to have a greater impact on reducing poverty in the region, it needs to better target the poor and focus more on reducing portfolio-at-risk (especially Morocco) (Ben Soltane, 2012). In addition, MFIs in this region are appealed to revise their interest rate since they seem to be very high. Last and not the least, this industry needs to attract several substantial new equity investors.

3. Related literature

According to the International Labour Organization (2007) efficiency in microfinance MFIs refers to efficient use of resources such as the subsidies, human capital and assets owned by MFIs to produce output measured in terms of loan portfolio and number of active borrowers. Efficiency in MFIs can be divided into two components in order to capture the double bottom line mission of MFIs, the financial efficiency and social efficiency. Financial efficiency in MFIs is based on technical efficiency, which is based on the assumption that the larger the productivity of MFIs is, the more the efficiency (Sanchez, 1997). MFI financial

Table 2
Malmquist index summary of annual means.

Year	Technical efficiency change (TEC) TEC = TE × SE	Technological change (TC)	Pure technical efficiency Change TE)	Scale efficiency change (SE)	Total factor productivity change (TFP) (Malmquist) TFP = TC × TEC
2006–2007	1.077	1.002	1.086	0.992	1.079
2007–2008	1.192	0.887	1.138	1.048	1.057
2008–2009	1.019	1.017	1.018	1.001	1.036
2009–2010	1.143	0.923	1.037	1.103	1.054
2010–2011	0.969	1.028	0.991	0.978	0.996
Mean	1.080	0.971	1.054	1.024	1.049

Source: Author's computation

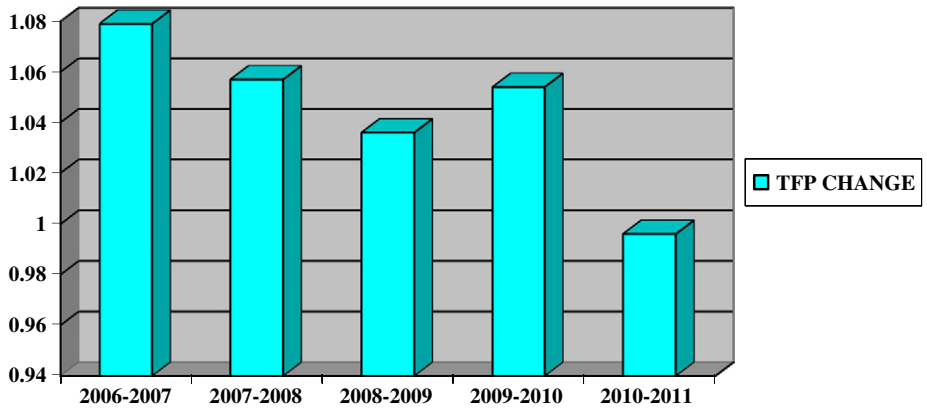
efficiency can be viewed as either production efficiency or intermediation efficiency depending on the choice of inputs and output variables. The production approach views MFIs as producers of services for poor clients and assumes that, the services are produced by utilizing physical resources of the institution such as capital, labor, assets and operating costs to produce loans, revenues, and savings (Ben Soltane, 2008; Gutiérrez-Nieto et al., 2007; Haq et al., 2010; Nghiem et al., 2006). Under intermediation efficiency, MFIs are considered as intermediary institutions which collect funds from economic units with excess resources (Savers) and channels them to economic units with the deficit (borrowers) hence transferring the purchasing power from surplus units to deficit units in the society (Kipesha, 2010). Social efficiency on other hands indicates the ability of MFIs to manage its resources such as assets and personnel (Von Stauffenberg et al., 2003). Social efficiency is related to welfare policy as it evaluates the efficiency to which resource utilization in MFIs impact to the society especially on women and poverty impact.

Traditionally, MFI's performance has been commonly measured using various accounting ratios. Though ratios provide great deal of information they are not without problem. Ratios provide only partial measures of efficiency and partial efficiency may be misleading when we draw conclusions on the overall efficiency of MFIs. Studies attempted to measure efficiency of MFIs using ratios include Baumann (2005), Farrington (2000) and Lafourcade et al. (2005). On the other hand, studies such as Abdul Qayyum and Ahmad (2006), Ahmad (2011), Ben Soltane (2008), Debdatta (2010), Desrochers and Lamberte (2003), Gutiérrez-Nieto et al. (2007), Haq et al. (2010), Hassan and Sanchez (2009), Hermes et al. (2008), Islam et al. (2011), Masood and Ahmad (2010), Mamiza, Michael and Shams (2010), Nghiem et al. (2006), and Oteng-Abayie et al. (2011) have applied frontier efficiency measures either the Data Envelopment Analysis or Stochastic Frontier Analysis.

Farrington (2000) identifies a number of accounting variables to reflect the efficiency of MFIs. These accounting variables are administrative expense ratio, number of loans per loan officer and loan officers to total staff, portfolio size, loan size, lending methodology, source of funds and salary structure as the efficiency drivers and hence as the measurements for MFI efficiency. Lafourcade et al. (2005) use cost per borrower and cost per saver as measure of efficiency. They found that African MFIs incur highest costs per borrower but have the lowest costs per saver. They also mention that regulated MFIs maintain higher efficiency through low costs per borrower and per saver. In contrast, African cooperative-MFIs are the least efficient with the highest cost per borrower. Nevertheless, cooperative-MFIs have the lowest cost per saver but unregulated MFIs have the highest. Likewise, the study by Baumann (2005) compared performance of selected MFIs (micro credit, and NGOs) that have poverty alleviation focus in South Africa and found out that most of MFIs in the country were not efficient as compared to other MFIs in the world.

In a similar vein, a large number of studies attempted to measure efficiency of MFIs while using the parametric and non-parametric methods. Desrochers and Lamberte (2003) have used stochastic frontier analysis, a parametric technique to measure efficiency for the measurement of efficiency of cooperative rural banks in the Philippines. They found that cooperative rural bank with good governance were more efficient than their counters laced by bad governance. Similarly, Hermes et al. (2008) used stochastic frontier analysis to examine a trade-off between outreach to the poor and efficiency of MFIs based on 435 MFIs and found that outreach and efficiency of MFIs are negatively correlated. Their finding further indicates that efficiency of MFIs is higher if they focus less on the poor and/or reduce the percentage of female borrowers. Likewise, Masood and Ahmad (2010) applied a stochastic frontier model to estimate the efficiency of 40 Indian MFIs for the period 2005–2008. They found that the mean efficiency level of MFIs is low. Further, the study found that regulated MFIs are less efficient and age of MFIs has a positive effect on efficiency. In the same way, Oteng-Abayie et al. (2011) applied a Cobb–Douglas Stochastic frontier model for Ghana MFIs for the period from 2007 to 2010. They found an average economic efficiency of 56.29%; and further age and saving indicators of outreach and productivity, and cost per borrower were found to be significant determinants of economic efficiency.

Abdul Qayyum and Ahmad (2006) follow up the DEA efficiency analysis with a sustainability assessment using scale parameter and ranked 25 MFIs, operating in three countries of Pakistan, India and Bangladesh in South Asia, on efficiency scores. The findings from the study reveal that, most of inefficiency MFIs was mainly technical in nature and only three MFIs were efficient in Bangladesh and only two MFIs were efficient in India. The study suggested that MFIs in South Asia should improve the managerial expertise and technology used in offering services in order to improve efficiency in such institutions. Similarly, Gutiérrez-Nieto et al. (2007) have adopted a DEA and multivariate analysis methodology to evaluate the performance of 30 MFIs in 21 Latin American countries using different combinations of inputs and outputs. This approach consists on determining in a first stage, the efficiency scores under different specifications. In a second stage the principal component analysis is used to explain differences in efficiency scores. None of these institutions has been efficient in all the specifications. According to Gutiérrez-Nieto et al. (2007) the level of efficiency depends on the specification chosen, which shows the importance and delicacy of the selection step of inputs and outputs. The results set evidence of the existence of a country effect and a non-governmental organization status effect (NGO/no-NGO). They conclude that NGOs are more efficient because of their ability to serve many customers while minimizing costs. This merely reaffirms the pursuit of the double goals of sustainability and social impact. The evaluation of efficiency of 35 MFIs in the Mediterranean countries during the period 2004–2009 while using DEA by Ben Soltane (2008) revealed the existence of relatively 8 efficient MFIs. Ben Soltane found that the size of MFI plays a negative role in its efficiency. It means that medium size institutions are more efficient than the others. The author concluded that the key of success of MFIs is their ability to establish, due to their small size, a relationship of trust with their customers which could have resulted in lower transaction costs. The study by Hassan and Sanchez (2009) investigated



Source: Author's estimation

Fig. 1. Total factor productivity change of the MENA MFIs 2006–2011. Source: Author's estimation.

technical efficiency and scale efficiency of MFI in three regions, Latin America, Middle East and South Africa and South Asia countries by comparing their efficiencies across the regions and across different types of MFIs. The study found out that technical efficiency was high in formal microfinance than in informal microfinance and the source of inefficiencies was found to be pure technical rather than scale suggesting that, MFIs reviewed are either wasting resources or are not producing enough output. Likewise, Haq et al. (2010) examined the cost efficiency of 39 MFIs across Africa, Asia and Latin America under two assumptions, MFIs as producer of loans to clients (productivity efficiency) and MFIs as intermediary institutions (Intermediation efficiency). The results indicated that nongovernmental MFIs were more efficient particularly under production efficiency. The results were consistent with the dual objective of MFIs of poverty alleviation and achieving financial sustainability. The results also indicated that banks with microfinance services outperform nonbank MFIs in terms of measures of efficiency under intermediation efficiency and that there was no trade off between efficiency and outreach. In consistence with previous studies, Debdatta (2010) used 3 years average data (2007–2009) to manage the problem of missing data in the panel on 39 MFIs in India using DEA technique and found only two efficient MFIs under constant returns to scale and six under variable returns to scale modeling. Similarly, Haq et al. (2010) analyzed the cost efficiency of 39 MFIs in Africa, Asia and Latin America by applying the DEA method. The results showed that non-governmental organizations (NGOs) are the most efficient given the production approach, while under the intermediation approach, banks providing microfinance services are the most efficient. As financial intermediaries, banks have the competitive advantage of access to local capital as well as global financial markets which is not the case for NGOs. In the same way, Ahmad (2011) has used the non parametric Data Envelopment Analysis to analyze the efficiency of MFIs in Pakistan. Both input oriented and output oriented methods have been considered under the assumption of constant return to scale technologies and microfinance should provide services on sustainable basis. A microfinance institution is said to be financially sustainable if without the use of subsidies, grants, or other concessional resources, it can profitably provide finance to micro enterprises on an acceptable scale. Likewise, Islam et al. (2011) empirically examined the efficiency of agricultural microfinance borrowers in rice farming in Bangladesh using DEA. Inefficiency effects are modeled as a function of farm-specific and institutional variables. The results of the study revealed that subsequent to effectively correcting for sample selection bias, land fragmentation, family size, household wealth, on farm-training and off farm income share are the major determinants of inefficiency. Nghiem et al. (2006) are the only to use both parametric and non-parametric approach. The implementation of the two approaches leads to similar estimates/scores of the MFIs' efficiency.

The most notable researches conducted on MFIs and Non-Bank Financial Institutions (NBFIs) productivities are by Gebremichael and Rani (2012) and Sufian (2007) using the Malmquist productivity index and suggesting that pure technical efficiency has largely contributed to MFI and NBFI technical efficiency progress.

4. Data and methodology

The analytical framework we have chosen to conduct our study is that of Middle East and North Africa (MENA) region while selecting ten countries: Egypt, Jordan, Lebanon, Morocco, Palestine, Sudan, Syria, Iraq, Tunisia and Yemen. We chose this framework because it is composed of developing countries where several successful experiments have been undertaken although some of them are experiencing a series of difficulties because of the Arab Spring.

The MFIs data are collected from individual institutions as reported to mix market (www.mixmarket.org), a nongovernmental organization whose object is to promote the exchange of information on the microfinance sector around the world. This database collects information on 85 MFIs operating according to international standards from ten countries in the MENA region. However, data cannot be generated from all the MFIs as some lack sufficient data while others are new to be included in the analysis. Therefore, additional data were collected from annual reports as well as financial statements specific to MFIs.

We finally selected 33 MFIs with the highest levels of information transparency. The sample is composed of 7 MFIs from Egypt, 6 from Jordan, 5 from Morocco, 1 from Tunisia, 5 from Yemen, 2 from Lebanon, 3 from Palestine, 2 from Syria, 1 from Sudan and 1 from Iraq. It covers three North African countries and seven middle-east countries. The latest information for the selected MFIs dates from 2006 to 2011.

4.1. The Malmquist productivity index

In the academic financial literature, there are several different methods that could be used to measure the productivity changes, which are Fisher index, Tornqvist index and the Malmquist Index. Indeed, the most often-used analytical tool to evaluate productivity change is the so-called Malmquist total factor productivity (TFP) index. According to Grifell-Tatje and Lovell (1996), the Malmquist index has three main advantages relative to the Fischer and Tornqvist indexes. Firstly, it does not require the profit maximization or the cost minimization assumption. Secondly, it does not require information

Table 3
Malmquist index summary of MENA MFI's means.

	Technical efficiency change (TEC)	Technological change (TC)	Pure technical efficiency change (TE)	Scale efficiency change (SE)	Total factor productivity change (TFP) (Malmquist)
ABA	1.002	0.904	1.009	0.994	0.906
CEOSS	1.087	0.958	1.015	1.071	1.041
DBACD	1.424	1.011	1.206	1.181	1.439
ESED	1.025	1.004	1.012	1.013	1.029
FMF	0.954	1.012	0.967	0.987	0.965
LEAD FOUNDATION	1.044	0.919	1.014	1.030	0.959
SBACD	1.193	1.015	1.199	0.995	1.210
AL THIQA	0.985	0.973	0.994	0.991	0.958
AL WATANI	0.960	1.042	0.985	0.975	1.000
AMC	1.045	0.919	1.027	1.018	0.960
DEF	1.028	1.017	0.934	1.101	1.045
MEMCC	1.032	0.918	1.026	1.006	0.947
MFW	1.045	0.929	1.027	1.018	0.971
TAMWEELCOM	1.220	0.902	1.187	1.028	1.100
AL MAJMOUA	1.119	1.017	1.118	1.001	1.138
AMEEN	1.032	0.949	1.026	1.006	0.979
AL AMANA	1.004	1.037	1.016	0.989	1.042
AMSSF/MC	0.917	0.962	0.913	1.005	0.882
FBPMC	1.113	0.975	1.012	1.100	1.085
FONDEP	1.379	0.945	1.276	1.081	1.303
INMAA	1.133	1.008	1.022	1.109	1.142
ASALA	1.137	0.965	0.989	1.150	1.097
FATEN	1.240	1.011	1.234	1.005	1.253
RYADA	1.065	0.964	1.032	1.032	1.026
PASED	0.965	0.936	1.026	0.941	0.903
FMFI-S	1.013	0.925	1.005	1.008	0.937
JABAL AL HOSS	1.040	0.928	1.034	1.006	0.965
ENDA	1.180	0.963	1.046	1.129	1.137
ABYAN	1.157	1.019	1.076	1.076	1.179
ADEN	1.008	0.937	1.116	0.904	0.945
AL AWAEL	0.994	0.969	1.213	0.820	0.963
AZAL	1.046	1.061	1.012	1.034	1.110
NMF	1.065	0.953	1.126	0.946	1.015
Mean	**1.080**	**0.971**	**1.057**	**1.022**	**1.049**

Source: Author's computation

on the input and output prices. Finally, if the researcher has panel data, it allows the decomposition of productivity changes into two components, i.e. technical efficiency change or catching up and technical change or changes in the best practice. Its main disadvantage is the necessity to compute the distance functions. However, the data envelopment analysis (DEA) technique can be used to solve this problem.

Given these reasons, among others, we have opted to choose the Malmquist productivity index to study productivity change and growth of MENA MFIs. This method (the Malmquist productivity index) measures the productivity change of decision making units (MFI in our case) 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 William et al., 2007).

The Malmquist productivity index has many attractive features. One is that it decomposes into a technical efficiency change index and a technical change index. Therefore, the MFI's productivity change can be attributed to either change in technical efficiency (i.e., whether MFIs are getting closer to the production frontier over time) or change in the technology (i.e., whether the production frontier is moving outwards over time), technological progress in the industry, or both. 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. Pure technical efficiency refers to the MFI's ability to avoid waste by producing as much output as input usage allows, or by using as little input as output production allows. Scale efficiency refers to the MFI's ability to work at its optimal scale.

The Malmquist productivity index was employed to measure the productivity change of MFIs 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. To define the Malmquist index, Fare et al. (1994) defined distance functions with respect to two different time periods:

$$D_0{}^t\left(x^{t+1},y^{t+1}\right)=\inf\left\{\theta|\left(x^{t+1},y^{t+1}/\theta\right)\in S^t\right\} \tag{1}$$

and

$$D_0{}^{t+1}\left(x^t,y^t\right)=\inf\left\{\theta|\left(x^t,y^t/\theta\right)\in S^{t+1}\right\} \tag{2}$$

The distance function in (1) measures the maximal proportional change in output required to make (x^{t+1}, y^{t+1}) feasible in relation to technology at time τ. Similarly, the distance function in (2) measures the maximal proportional change in output required to make (x^t, y^t) feasible in relation to technology at time $t+1$. The output-oriented Malmquist productivity change index can be expressed as follows:

$$M_o\left(x^{t+1},y^{t+1},x^t,y^t\right)=\frac{D_o^{t+1}\left(x^{t+1},y^{t+1}\right)}{D_o^t\left(x^t,y^t\right)}\left[\frac{D_o^t\left(x^{t+1},y^{t+1}\right)}{D_o^{t+1}\left(x^{t+1},y^{t+1}\right)}\frac{D_o^t\left(x^t,y^t\right)}{D_o^{t+1}\left(x^t,y^t\right)}\right]^{\frac{1}{2}} \tag{3}$$

The term outside the brackets shows the change in technical efficiency between time t and $t+1$, representing the change in the relative distance of the observed production from the maximum potential production while the geometric mean of the two ratios inside the brackets measures the shift in technology between the two periods t and $t+1$; this could be called technological progress. The product of the two components (efficiency change and technical change) is the Malmquist productivity change (total factor productivity change). In addition, technical efficiency change can be further decomposed into pure technical efficiency change and scale efficiency change. So:

$$\text{Efficiency change} = \frac{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \tag{4}$$

$$\text{Technical change} = \left[\frac{D_o^t\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)} \frac{D_o^t\left(x^t, y^t\right)}{D_o^{t+1}\left(x^t, y^t\right)}\right]^{\frac{1}{2}} \tag{5}$$

The Malmquist productivity index can be interpreted as a measure of total factor productivity (TFP) growth. In each of the formulas above, a value greater than one indicates an improvement in productivity, as well as improvement in efficiency and technology from the period t to period $t+1$ while a value smaller than one presents deteriorations in performance over time.

4.2. Selection of inputs and outputs

The primary purpose of the production function is to explain the maximum quantity of output the firm can produce from a specified set of inputs and other relevant factors that might explain the quantity of output produced. In the literature of bank efficiency, researchers consider three broad approaches (the intermediation, the production approach, and the assets approach). The first view, the intermediation approach, considers financial institutions mainly as mediators of funds between depositors and investors. Under this approach, deposits are considered inputs since they constitute the raw material to be transformed into loans and investible funds (Ashton, 1998; Lang and Welzel, 1996; Sealey and Lindley, 1977). The second, the production approach, considers financial institutions as producers of loans and providers of services for account holders. Accordingly, deposits should be considered an output because they involve the creation of value added associated with liquidity, safekeeping and payments services provided to depositors (Benston et al., 1982; Hunter and Timme, 1986). Finally under the assets approach it is assumed that the basic function of any financial institution is the creation of credit (loan). And hence the value of assets of financial institutions acts as output in this approach.

Following Fare et al. (1994), this paper adopts the output-oriented Malmquist productivity change index, referring the emphasis on the equi-proportionate increase of outputs, within the context of a given level of input. This choice can be attributed to the fact that the MFIs are indeed interested in increasing outreach i.e. providing credit to the poor people which commensurate with not only their social mission but also contributes towards sustainability as well by collecting more revenues from lending. In addition to that they compete in an imperfect economic environment as the markets for MFIs are not as well developed as the conventional banking sector. And they always have restricted amount of money and human resource (inputs) to spend on unlike commercial banks which can generate money from shareholders (Nawaz, 2010). The selection of specifications with correct inputs and outputs in the context of MFIs is crucial. Based on the literature and following the pattern of Gutiérrez-Nieto et al. (2007), this study uses two inputs and three outputs; the number of employees, and operating expenses/administrative expenses are specified as the two inputs whereas the outputs are interests and fee income, gross loan portfolio, and loans outstanding. Table 1 presents descriptive statistics of the inputs and outputs selected for this study.

5. Results and discussion

Table 1 depicts descriptive statistics on the variables used in the econometric analysis of productivity changes including their mean, standard deviation, minimum and maximum values or the sample of 33 MFIs during the period 2006–2011. As we can see from the table the variables used in the study vary significantly among the sample of MFIs and suggested that the sample observation composed of large and small MFIs as well, as measured in terms of gross loan portfolio and number of loan outstanding among others.

Following Fare et al. (1994) the Malmquist (output oriented) TFP change index has been calculated. A value of the index greater than one indicates positive TFP growth while a value less than one indicates TFP decline over the period. Productivity change is then decomposed into technological change (TC), and technical efficiency change (TEC), where TFP = TC × TEC. An improvement in TC is considered as a shift in the best-practice frontier, whereas an improvement in TEC is the "catch-up" term. The technical efficiency change (TEC) is further decomposed into the scale change (SE) and pure efficiency change (TE) components TEC = TE × SE. The value of the decomposition is that it attempts to provide information on the sources of the overall productivity change in the microfinance industry of the MENA countries.

Productivity change estimates and evolution are summarized below in Table 2 and Fig. 1. Overall, the Malmquist productivity change experienced by the micro finance industry has averaged 4.9% per year and suggest improvement in performance of MFIs from 2006 to 2011. Similarly, and as shown by the result over the sample period, the average annual rate of technical efficiency change is 8% while the rate of technological change is −2.9%.

As shown in Table 2 the analysis of the change in efficiencies (Malmquist index) shows that productivity has been decreasing during the period 2006–2011 even though all the MENA MFIs have positive TFP growth (1) with the exception of the year 2010–2011 (slight decline in productivity, which is 4% due to regional uprising known as the "Arab Spring"). The microfinance industry has reported overall productivity slight decline in the study period (−2.2%, −2.1%, 1.8% and −5.8% in the years 2007–2008, 2008–2009, 2009–2010 and 2010–2011 respectively). Nevertheless, the result of the study indicated that over the period the Malmquist productivity change experienced by the microfinance industry as a whole has averaged 4.9% annually.

By decomposing the Malmquist index, it is possible to determine the sources of productivity growth. As explained previously, technical efficiency change (TEC) and technological change (TC) are the efficiency changes (movement of microfinance industry towards the frontier "catching up") and technological changes (frontier shift) respectively. In this regard, the sources of growth or decline in MENA microfinance industry are due to TEC, TC, or both. From Tables 2 and 3, it is obvious that the main source of TFP growth for the MENA MFIs was attributed to the technical efficiency change TEC (8% increase) as the result depicted that 27 out of 33 MFIs (81%) have shown improvement in TEC. On the contrary, only 12 out of 33 (36%) MFIs have shown improvement in TC but still the industry as a whole has exhibited a decline in technological change (2.9% decrease over the period) and suggested that there has been a deterioration in the performance of the best practicing MFIs. Furthermore, during the study period the decline in productivity (even though all the MENA MFIs have positive TFP growth with the exception of the year 2010–2011) as the result of an average

technological decrease of 2.9% was offset by the average efficiency increase of 8% and turn the industry to exhibit a 4.9% overall productivity gains.

Turning now to discuss the decomposition of technical efficiency change into its pure technical efficiency and scale efficiency components depicts clear findings. During the period of study, our results showed that pure technical efficiency increased by 5.4% while scale efficiency contributed on average 2.4% increase and hence suggested that during the study period the MENA MFIs have experienced mainly an increment of pure technical efficiency (improvement in management practices) rather than in improvement in optimum size (scale efficiency change).

Our findings corroborate Gebremichael and Rani (2012) research examining the total factor productivity change in the Ethiopian MFIs and showing that pure technical efficiency has largely contributed to Ethiopian MFIs technical efficiency progress. According to this research, the Ethiopian MFIs have experienced an increase in the pure technical efficiency as well as in the scale efficiency (8.9% and 1.1% respectively). In the same vein, our study confirms the results by Sufian (2007), which suggest that pure technical efficiency has greater positive impact to Malaysian NBFI technical efficiency especially during the early part of the studies. With regard to the banking context, our study lends strong support to the results by Krishnasamy et al. (2004), which suggest that PTE has largely contributed to Malaysian banks technical efficiency improvement.

Finally, an important implication for the MENA MFIs is that they need to pursue a technological progress in order to meet the dual objectives of reaching many poor people (social mission) and financial sustainability.

6. Conclusion

The present study was designed to examine productivity change in Middle East and North Africa MFIs over the period of 2006–2011 using the Malmquist productivity index and a balanced panel dataset of 198 observations from 33 MFIs. The selection of inputs and outputs is determined by our understanding of the dual objectives of MFIs: achieving self-sufficiency by covering its costs and reaching many poor clients (outreach). Therefore, we specify two inputs and three outputs; the number of employees, and operating expenses are specified as inputs whereas the outputs are interests and fee income, gross loan portfolio, and number of loans outstanding.

The empirical findings of the study indicate that the microfinance industry has reported overall productivity regress in the study period even though all the MENA MFIs have positive TFP growth with the exception of the year 2010–2011. In addition, our study indicates that over the period the Malmquist productivity change experienced by the MENA microfinance industry as a whole has averaged 4.9% annually which was mainly attributed to technical efficiency change. Though few MFIs (12 out of 33 (36%)) have shown improvement in technological change, the industry as a whole has exhibited a decline in technological change (2.9% decrease over the period) and suggested that there has been deterioration in the performance of the best practicing MFIs. By decomposing the Malmquist index, it is possible to determine the sources of productivity growth. Accordingly, the result showed that during the study period the MENA MFIs have experienced mainly an increment of pure technical efficiency (improvement in management practices) rather than an improvement in optimum size. Our research lends strong support to previous studies conducted by Krishnasamy et al. (2004), Sufian (2007) and Gebremichael and Rani (2012) suggesting that PTE has largely contributed to Malaysian banks' technical efficiency improvement. Overall, an important strategic implication for the MENA microfinance industry is that they need to pursue a technological progress in order to meet the dual objectives of reaching many poor people and financial sustainability.

Appendix A. microfinance institution names used in the study

ABA
CEOSS
DBACD
ESED
FMF
LEAD FOUNDATION
SBACD
AL THIQA
AL WATANI
AMC
DEF
MEMCC
MFW
TAMWEELCOM
AL MAJMOUA
AMEEN
AL AMANA
AMSSF/MC
FBPMC
FONDEP
INMAA
ASALA
FATEN
RYADA
PASED
FMFI-S
JABAL AL HOSS
ENDA
ABYAN
ADEN
AL AWAEL
AZAL
NMF

Appendix B. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.econmod.2014.02.035.

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