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Social and Financial Efficiency of Islamic Microfinance Institutions: A Data Envelopment Analysis Application

Abstract

Microfinance has been developed as alternative solution for global poverty alleviation effort in the last 30 years. Microfinance institution (MFI) has unique characteristic wherein they face double bottom line objectives of outreach to the poor and financial sustainability. This study proposes a two-stage analysis to measure Islamic Microfinance institutions (IMFIs) performance by comparing them to conventional MFIs. First, we develop a Data Envelopment Analysis (DEA) framework to measure MFIs' efficiency in its double bottom line objectives, i.e. in terms of social and financial efficiency. In the second stage non-parametric tests are used to compare the performance and identify factors that contribute to the efficiency of IMFIs and MFIs.

Keywords: Data Envelopment Analysis, Islamic Microfinance, Microfinance Institutions, Efficiency, Performance Measurement

1. Introduction

Microfinance has been one of the solutions prescribed for global poverty alleviation over the past three decades (Koveos & Randhawa, 2004; Shaw, 2004). It has since achieved substantial attention and focus, particularly in achieving the Millennium Development Goals (MDG) of halving global poverty in 2015 (Balkenhol, 2007). It addresses formal banking system failure in eradicating vicious circle of poverty (Chowdhury & Mukhopadhaya, 2012a; Conning, 1999) by extending financing to the poor, or 'the unbankable' (Simanowitz & Walter, 2002) who are deemed too risky thus excluded by formal banking (Di Martino & Sarsour, 2012; Vanroose & D'Espallier, 2013). Furthermore, small loans that they demanded are considered unprofitable (Johnston & Morduch, 2008).

Ironically, microfinance institutions (MFIs) charge high interest rates; mostly even much higher than banks owing to high costs incurred from relatively small loan (Ahmed, 2002; Diop et al., 2007; Obaidullah, 2008; Rahman, 1999), subjected them to criticism (Copestake, 2007a). Moreover, MFIs face difficulty penetrating into regions with substantial Muslim

population observing religious prohibition of interest (The Louis Berger Group, 2010; UN-HABITAT, 2005), creating unmet demands for financing among the poor therein (Segrado, 2005). Thus, Islamic microfinance concept had been developed as alternative for Muslim borrowers; based on Islamic financial contracts (Karim et al., 2008).

Nevertheless, the yardstick of microfinance success lies in its actual performance versus its *raison d'être* of poverty alleviation, i.e. 'the extent to which it alleviates poverty levels of its existing and potential customers' (Nanayakkara & Iselin, 2012, p. 173). Specifically, MFIs are different from traditional financial institutions due to existence of double bottom line objectives of outreach and financial sustainability (Tulchin, 2003), i.e. aiding the poorest out of poverty whilst striving to sustain operation for long term. Thus, both outreach and financial sustainability are MFIs' objectives (Abdelkader et al., 2012; Hermes & Lensink, 2011; Vanroose & D'Espallier, 2013) and likewise becoming standard on which their performance is judged (Yaron, 1994).

Whilst IMFIs starting to play instrumental part in Muslim-populated regions in Asia, Africa, Central Europe and Middle East and North Africa (Karim et al., 2008; Obaidullah & Khan, 2008; Parveen, 2009), there are very scant, if any, comprehensive empirical studies assessing their actual performance relative to dual objectives. Given its potential, comprehensive empirical study is dreadfully needed to assess IMFI performance vis-à-vis double bottom objectives and to compare them against conventional MFI counterparts; assessing its viability as alternative in poverty alleviation to gain wider support from governments and donors.

This study thus proposes relative efficiency as a performance criterion that can be applied equally to measure overall, social and financial aspects of MFI performance (Balkenhol, 2007). Specifically, this study proposes the use of Data Envelopment Analysis (DEA), a non-parametric linear programming-based efficiency analysis. It constructed a piece-wise frontier from all best-performing MFIs; thereafter individual MFI's relative efficiency is calculated against MFI(s) with similar characteristics/attributes located in the frontier as its benchmark(s). From efficiency perspective, an MFI must strive for efficiency in its social and financial objectives. DEA enables different specifications to measure overall efficiency, social efficiency and financial efficiency (Gutiérrez-Nieto et al., 2009).

This research seeks to contribute towards microfinance and Islamic microfinance studies, particularly in currently limited empirical studies in Islamic microfinance performance, as well as towards DEA literatures in application of DEA as an adept methodology in microfinance performance assessment. Finally, this study serves as reflection and wake-up call to IMFIs to improve future performance thus contributing towards the development of Islamic microfinance.

The rest of the paper is organised as follows: next section provides general background on microfinance, i.e. conventional and Islamic MFIs concept differences, MFI operational objectives, and application of efficiency as performance measures. Section 3 explores conceptual framework for efficiency measurement and DEA, further described in section 4 with DEA specifications used in this study. Dataset is laid out in section 5 and subsequently followed by first-stage and second-stage analysis in section 6 and 7, respectively. Results from these analyses are discussed in section 8 with direction for further research is proposed in section 9.

2. Microfinance

(a) Microfinance and Islamic Microfinance

The main role of MFI is expanding economic opportunity and financial market to the poor (Copestake et al., 2002; Seibel & Agung, 2005; Seibel, 2008; Wright & Copestake, 2004), which is considered as effective solution in achieving poverty reduction and other socioeconomic benefits (Li et al., 2011). The underlying assumption being that among causes of poverty is lack of economic opportunities, which can be bridged by microfinance (Comim, 2007) since it is regarded as capable method to assist in distribution of income support and in creation of income-generating activities (Diop et al., 2007).

Yet, relatively small loan extended by MFIs incurred similar transaction costs with large loans, which increase further when MFIs target poor borrowers due to three factors: small amounts, location of poor borrowers and group-lending method to mitigate credit risks hence high fixed costs (Diop et al., 2007). High interest rates is thus charged to cover these transaction costs (Chahine & Tannir, 2010; Conning & Morduch, 2011; Takahashi et al., 2010; Visconti & Muzigiti, 2009) with justification that borrowers return is high in percentage

terms thus paying for high interest rates is not perceived as harmful for the borrowers (Ferro Luzzi & Weber, 2007; Obaidullah & Khan, 2008).

Nevertheless, high interest rate is argued to be problematic. It is documented that high interest rates combined with over-indebtedness and loan misuse often eventually led to excesses ranging from borrowers caught in spiralling debt (Hashemi et al., 2007), resulted in poor borrowers selling whatever asset they have (Parveen, 2009) to the extreme cases of microfinance-linked suicides in Andhra Pradesh, India in 2010 (Conning & Morduch, 2011; van Rooyen et al., 2012) and in Sri Lanka (Obaidullah & Mohamed-Saleem, 2008). Adverse selection increases whereby customers borrow without intention to repay (Diop et al., 2007). Moreover, MFI operatives often found acting equivalent to loan shark in boosting repayment (Servin et al., 2012). This study concurs with Armendariz de Aghion and Morduch (2005) that poor borrowers will not be able to pay continuous high interest in long term.

Islamic microfinance concept was later developed as alternative in regions with substantial Muslim population observing faith-based prohibition of interest. It aims to provide better model in addressing embedded issues of high interest rate and others in mainstream/conventional microfinance (Ahmed, 2002, 2007). Employing interest-free contracts, Islamic microfinance institution (IMFI) theoretically extends in-kind, in lieu of monetary, assistance to the poor thereby overcoming misuse and over-indebtedness (Ahmed, 2002; Obaidullah, 2008). Islamic microfinance broadens concept of microcredit-cum-trainings by incorporating charity in financing, in the form of *zakah* (alms) and *waqf* (endowment), assisting the poorest in basic necessities and avoiding misuse of productive loans into consumption purposes (Ahmed, 2007; Wilson, 2007). Although relatively small in scale, Islamic microfinance has grown globally following the growth of wider Islamic finance industry (Karim et al., 2008).

(b) Microfinance and double bottom line objectives

Outreach and sustainability are dual objectives of MFI operation (Tulchin, 2003). Outreach is defined as social value of MFI output in six aspects, i.e. depth, breadth, length, scope, worth of users, and cost to users (Navajas et al., 2000; Schreiner, 2002). These aspects are the

defined as the following: *depth of outreach* is defined as the extent to which MFI penetrate deeper to the poorest, *breadth* is measured by number of borrowers assisted, *length* is the time frame of microfinance service is provided to a community, *scope of outreach* refers to number of services variety provided (e.g. loan, savings and others), *worth of users* is how much clients value the service provided based on how it matches clients' needs, and *cost to users* is calculated by the total costs clients have to pay for the service as the sum of price costs (interest and fee) and transaction costs. Among these aspects, the focus on outreach in most studies is on the depth and breadth of outreach (Quayes, 2012). On the other hand, sustainability is defined as permanence or the MFI ability to sustain its microcredit and other operations as a viable financial institution (Cull et al., 2007; Navajas et al., 2000). This is equally important as MFI is expected to operate in long term to have profound impact on the poor (Balkenhol, 2007; Quayes, 2012).

Morduch (1999) observed that MFIs' sound financial performance does not guarantee depth of outreach, let alone poverty alleviation; whilst Navajas et al. (2000) examined that MFIs serve households that are either just below the poverty line – 'the richest of the poor' – or just above the poverty line – 'the poorest of the rich' – in its strive to be profitable. Schreiner (2002) concluded that the depth of outreach and financial sustainability are like conflicting objectives thus a trade-off exists: outreach is only attained by sacrificing financial sustainability or by relying more on donations or subsidies. He suggested MFIs to strive for breadth, scope and length aspects of outreach instead of depth. Studies by Hermes and Lensink (2011), von Pischke (1996), Mersland and Strøm (2008), Hermes et al. (2011) and others also focused on this trade-off.

Cull et al. (2007) suggested that MFIs can sustain their profitability by not lending the poorest, given higher cost per dollar of loan, but to the 'less poor' instead as overall welfare will improve. Yet, this study argued along with Ahmed (2002), that microfinance is actually a response to the failure of trickle-down development policy to alleviate poverty in most developing countries, owing to asymmetric information.

Simanowitz (2007) argued that MFI can and should manage this objectives trade-off. Paxton and Cuevas (2002) cited in Quayes (2012:3422) argued that, contrary to Diop et al. (2007), group loan schemes actually reduce costs in lending small loans hence trade-off is managed.

Stiglitz (1990) supported this view since similar structure of small loans minimises costs. Regarding breadth versus depth of outreach, Quayes (2012) argued that the rapid growth of microfinance in the past two decades has spurred the growth in number of borrowers both at the industry and at the firm level yet this does not necessarily means reaching out to the poorest, as also found by Navajas et al. (2000). Since helping the poorest is the *raison d'être* of microfinance, the depth of outreach, which is generally measured using proxy of average loan balance per borrower, can be regarded as measure for quality of outreach whilst breadth of outreach represents quantity in outreach (Quayes, 2012). Thus, studies concerned with outreach to the poorest have focus on both; as in Armendariz and Szafarz (2011), Nanayakkara and Iselin (2012), and Simanowitz (2003). Furthermore, Haq et al. (2010), Fluckiger & Vassiliev (2007) and Gutiérrez-Nieto et al. (2009) among others, empirically observed that both outreach and financial sustainability can be pursued in best-practice MFIs.

(c) Efficiency as a measure of MFI performance

Traditional financial indicators are not sufficient to assess microfinance performance since, due to its social mission, sustainability in MFI is not necessarily limited to profitability but rather to MFI ability 'to operate in long term without threat of bankruptcy' (Nanayakkara, 2012, p. 94). Thus, whilst some MFIs deliberately focus on profitability to reach sustainability (e.g. bank-MFI), there exist other MFIs where profitability is not a major focus and achieve sustainability by contribution from donors or external grant, e.g. non-governmental organisation-based MFI (NGO-MFI). Using traditional financial ratios to measure MFI performance can also be ambiguous: an MFI can excel in one ratio but fail in others hence difficulty in overall performance benchmarking (Bogetoft & Otto, 2011). Furthermore, separate ratios cannot measure how different inputs concurrently affect multiple outputs in transformation process (Thanassoulis, 2001).

Due to this partiality problem, MFI stakeholders may face confusion in benchmarking overall performance of an MFI against other MFIs, which is essential to drive MFI performance improvement (Balkenhol, 2007). Fluckiger and Vassiliev (2007) added that aggregation problem occurs when all these indicators are to be combined into one assessment criterion. Likewise, basing performance to single indicator overlooks any

substitutions, interactions and trade-offs between several performance measures (Bogetoft & Otto, 2011; Zhu, 2003).

Efficiency is thus proposed in this study as MFI performance measurement criterion due to its capability to cover both different aspects of microfinance and to be applied to both commercial and not-for-profit MFIs (Balkenhol, 2007). Efficiency relates usage of input to create output; traditionally defined as ratio of output over input, e.g. cost per unit, production per labour hour (Cooper et al., 2000). Yet, efficiency in microfinance studies is still in ratio form; though evolving from 'operational efficiency' in Micro-Banking Bulletin 1997 into five ratios in Micro-Banking Bulletin 2006 (Balkenhol, 2007), hence partiality problem.

Consequently, modern efficiency approach capable to be applied to multiple-inputs and multiple-outputs, to all types of MFIs, and to benchmark overall MFI performance is needed. One such method is Data Envelopment Analysis (DEA), described in the following sections.

3. Conceptual Framework for Efficiency Measurement

(a) Efficiency

Efficiency in production theory refers to the utilisation of inputs into outputs. It concerns with optimal combination of inputs to produce maximum outputs or producing given outputs with least quantity of inputs hence minimising waste. Farrell (1957) widened this concept into relative efficiency, i.e. the extent to which actual observable use of resources by an organisation to produce a given quality of outputs matches optimal use of these resources (Bhagavath, 2006). Farrell (1957) classified the concept of efficiency into productive (technical) efficiency, price (allocative) efficiency, and economic (cost) efficiency. Technical efficiency deals with utilisation of inputs to produce outputs relative to best practice organisations with similar characteristics (Bhat et al., 2001; Emrouznejad & Anouze, 2010); measuring the extent of wasted resources from transformation process (Masiye et al., 2006). It is influenced by managerial practice and operational scale (Thanassoulis, 2001). Allocative efficiency calculates whether resources have been allocated to produce outputs with highest possible value, i.e. with lowest possible cost (Masiye et al., 2006; Thanassoulis, 2001);

indicating the influence of input prices. Cost or economic efficiency is the combination of technical and allocative efficiency; measuring organisation's ability to produce without waste and to allocate resources in their highly valued use (Coelli et al., 2005; Masiye et al., 2006) whereby an organisation can only reach overall cost or economic efficiency if it is both technically and allocatively efficient (Thanassoulis, 2001). As the prices of inputs and outputs in microfinance context are not easily determined, e.g. number of borrowers or portfolio at risk, this study will solely focus on technical efficiency Besides these, scale efficiency calculates the impact of scale size by measuring an organisation's technical efficiency at its current production scale relative to that at its most productive scale size (Coelli et al., 2005; Thanassoulis, 2001).

Data Envelopment Analysis

Developed by Charnes et al. (1978), Data Envelopment Analysis (DEA) is a non-parametric method that expands single input-output productive efficiency concept from Farrell (1957) into efficiency assessment in transformation process of decision-making unit (DMU) with multiple-inputs and multiple-outputs. Using linear programming, it forms a 'floating' piece-wise linear production frontier on top of all data as best-practice benchmark (or reference set) against which each DMU is assessed, hence the term 'envelopment' (Cook & Zhu, 2005; Emrouznejad & Anouze, 2010; Fluckiger & Vassiliev, 2007). Technical Efficiency is calculated as distance of DMU to reference set on the frontier; creating relative efficiency measure for all DMUs (Cook & Zhu, 2005; Cooper et al., 2004; Emrouznejad & Anouze, 2009). Since its beginning in 1978, there has been tremendous growth both in modelling and applications in DEA studies in various sectors (Emrouznejad et al., 2008). DEA excels in assessing efficiencies without *a priori* assumption on the distribution and production function (Cook & Zhu, 2005; Cooper et al., 2004) thus shines in situation where inputs-outputs relationship is not straightforward.

Consequently, DEA is an appropriate method for MFI assessment whereby functional relationship between multiple inputs and outputs therein are often not directly observable. MFI effort to reach its double bottom line objectives can be perceived as efficiency problem, i.e. how an MFI transforms resources (inputs) to reach these dual objectives (outputs) compared to its best practice peers. As per Gutiérrez-Nieto et al. (2009), MFI dual objectives

can be perceived as social efficiency and financial efficiency. Though still scant, DEA has thus far been used in several MFI studies.

Two basic DEA models are CCR model of Charnes et al. (1978) and BCC model of Banker et al. (1984). CCR model assesses technical efficiency under Constant Return to Scale (CRS) condition hence CRS model. Multiple inputs and outputs for a given DMU are linearly aggregated into single 'virtual' input and output in the following manner:

$$Virtual\ Input = v_1 x_1 + \ldots + v_i x_i = \sum_{i=1}^{m} v_i x_i$$

$$Virtual\ Output = u_1 y_1 + \ldots + u_r y_r = \sum_{r=1}^{s} u_r y_r$$

$$Efficiency = \frac{virtual\ output}{virtual\ input} = \frac{\sum_{r=1}^{s} u_r y_r}{\sum_{i=1}^{m} v_i x_i}$$

Whereby v_i and u_r are weights for observed input x_i and for observed output y_r, respectively. Efficiency score is assigned for each DMU in a way that maximise the ratio of weighted output to weighted input. BCC model in Banker et al. (1984) modifies CCR model by applying a more realistic assumption of Variable Returns to Scale (VRS) wherein each DMU is allowed to exhibit different returns to scale due to different environment, hence VRS model. CRS is only valid if a DMU operates at its most productive scale size yet that is often not the case. Scale efficiency causes the difference between VRS technical efficiency of a given DMU, i.e. pure technical efficiency, to its CRS technical efficiency, i.e. global technical efficiency (Coelli et al., 2005; Thanassoulis, 2001). Two approaches in basic DEA models are *input-orientated*, i.e. maximises proportional inputs reduction whilst holding outputs constant, and *output-orientated*, which maximises the proportional outputs increase whilst keeping inputs constant, as in the following equation (1) and (2), respectively.

$$\theta^* = Min\ \theta$$

$$Subject\ to:$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}\ , \qquad r = 1,2,\ldots,s;$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0}\ , \qquad i = 1,2,\ldots,m; \qquad (1)$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0\ , \qquad j = 1,2,\ldots,n.$$

$$\phi^* = Max\ \phi$$

$$Subject\ to:$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq \phi y_{r0}\ , \qquad r = 1,2,\ldots,s;$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{i0}\ , \qquad i = 1,2,\ldots,m; \qquad (2)$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0\ , \qquad j = 1,2,\ldots,n.$$

Banker et al. (1984) added $\sum_{j=1}^{n} \lambda_j = 1$ in the constraint set to represent convexity constraint for λ_j in VRS condition; ensuring a DMU to be compared only to similarly-sized DMUs with similar return to scale. Pure technical efficiency scores from BCC model is thereby greater or equal to global technical efficiency scores from CCR model as DMU is measured relative to smaller number of DMUs (Thanassoulis, 2001).

4. Measuring MFIs Performance: Social and Financial efficiency

Assessment framework

There are different approaches to assess MFIs performance as financial institutions, i.e. production or intermediation approach (Athanassopoulos, 1997; Berger & Humphrey, 1997). Under production approach, financial institutions are regarded as production units using capital and labour as inputs to produce outputs of loans, deposits, and other financial services. Conversely, under intermediary approach, they are regarded as financial intermediaries using inputs of deposits from economic agents with fund surplus to produce outputs of loans and other financial services to economic agents in deficit (Athanassopoulos, 1997; Kipesha, 2012). Thus, the role of deposit is different, i.e. as output in production approach but as input in the intermediary approach (Balkenhol, 2007; Gutiérrez-Nieto et al., 2007). Since many IMFIs and their conventional MFIs in dataset are not collecting deposit

hence production approach is applied herein, as in many DEA microfinance studies (e.g. Fluckiger & Vassiliev, 2007; Gutiérrez-Nieto et al., 2009; Gutiérrez-Nieto et al., 2007; Haq et al., 2010; Hassan & Sanchez, 2009; Kipesha, 2012; Sedzro & Keita, 2009).

This research applied both output-orientated and input-orientated CCR and BCC models in its DEA analyses. Output-orientated model is used because microfinance units naturally strive to maximise outputs (dual objectives) given limited available inputs. Nevertheless, input-orientated model is also applied herein so as to provide comparison in a condition where MFIs are unable to increase outputs due to geographical, demographical or regulatory restriction thus only face option of lowering inputs to increase efficiencies. As differences in operational size may affect efficiency, BCC model using VRS assumption is intuitively more befitting to measure MFIs performance. Nevertheless, CCR model is also observed to compare to efficiency at optimal scale and to calculate scale efficiency.

Table 1: DEA Input variables

Inputs	Initial	Definition	Usage in literatures	Unit
Assets	A	Total wealth available to MFI from capital and borrowings for its transformation process. It is used as inputs to represent capital for production approach.	Bassem (2008), Kipesha (2012) and Gutierrez-Nieto et al. (2009)	USD '000
Operating Expense	O	Expenses related to operations, e.g. all personnel expense, depreciation and amortization, and administrative expense. It is used as input in production approach since production process will not be viable in the long run if outputs were produced at high costs hence need to be managed to avoid waste.	Gutiérrez-Nieto et al. (2007), Gutiérrez-Nieto et al. (2009), Hassan and Sanchez (2009) and Athanassopoulos (1997)	USD '000
Portfolio at Rixk 30 days	R	Percentage of total loan outstanding at risk of default by having one or more principal or instalments in arrears more than 30 days. This variable is used herein as input in production approach to represent risk in transformation process as less risk is favourable for the firm.	As far as we concerned, it has not been used as input in other DEA – microfinance literatures.	%
Employee	E	Labour input, i.e. all individuals employed by MFI, induding contract employees or advisor whether or not listed on MFI employee roster	Athanassopoulos (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Kipesha (2012), and Haq et al. (2010)	Numeric

DEA input-output selection

From literatures, DEA in this study utilises four inputs representing aspects of capital and labour in production and three outputs, i.e. two outputs representing outreach (social objective) and one output representing sustainability (financial objective), as presented in Table 1 and Table 2. Data thereof are obtained from MiX database[1].

Table 2: DEA Output variables

Outputs	Initial	Definition	Usage in literatures	Unit	MFI Objective (Efficiency) Represented
Financial Revenue	F	Revenue from loan portfolio, including margin rate charged in Islamic microfinance loan. It is used as output in production approach and proxy for s*ustainability* since an MFI that cannot collect enough revenue will not be viable to operate in the long run by itself	Gutiérrez-Nieto et al. (2009) and Hassan & Sanchez (2009).	USD '000	Sustainability (Financial Efficiency)
Inverse of Average Loan Borrower	I	Inverse format of average loan balance per MFI borrowers, which is a widely used proxy to measure *depth of outreach*; standardized over gross national income (GNI) per capita to remove currency & purchasing power parity difference. Usage of inverse format so as to have characteristic as output where larger value means better.	Modification from literatures. Gutiérrez-Nieto et al. (2009) use average loan borrower as index with number of borrower whilst we use them separately.	%	Outreach (Social Efficiency)
Borrowers	B	the number of individual or entity who currently has outstanding loan balance with MFIs or is primarily responsible for repaying any portion of the Gross Loan Portfolio. Herein, it is used an output to resemble the *breadth of outreach*.	Modification from literatures. Most literatures use number of women borrowers, e.g. Cull et al. (2007) and Nghiem et al. (2006).	Numeric	Sustainability (Financial Efficiency)

It should be noted herewith from this input-output selection: (1) although as far as we are concerned it has never been used before in DEA-microfinance studies, we selected Portfolio at Risk 30 days as it is one of the most important indicators in microfinance literature as warning sign of future delinquency problem (Rosenberg, 2009). (2) Gutiérrez-Nieto et al. (2009) used standardized average loan balance in an index of the benefit to the poor in combination with borrowers, whilst we keep these separately as output to differentiate *quality* and *quantity of outreach* and to avoid problem associating with the use of index as DEA input/output (Emrouznejad & Amin, 2009). (3) We upholds using number of active borrowers as output due to IMFI emphasis on family borrowers as opposed to solely women

[1] Data in Microfinance Information Exchange (MiX) is collected from MFIs globally; adjusted and standardized thereafter to make it uniform and comparable. MiX also ranks its contributing MFIs' transparency using scale of 1 to 5 diamonds for the least transparent to the most transparent.

borrowers (Ahmed, 2002); thereby male head of the household and women partner will collectively be loan agreement signatories, putting thereunto repayment responsibility and discouraging loan misuse by male partner.

DEA model specifications

In DEA assessment for overall efficiency as well as social and financial efficiency in isolation, in common with (Gutiérrez-Nieto et al., 2009), as in Table 3 three different specifications are utilised:

Table 3: DEA Model Specifications

DEA specifications	Efficiency represented	Inputs variables	Outputs variables
AORE-FIB	Overall efficiency	• Assets (A) • Operating expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Financial revenue (F) • Average loan balance per Borrower over GNI per capita (in Inverse form) – (I) • Number of borrowers (B)
AORE-F	Financial efficiency	• Assets (A) • Operating Expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Financial revenue (F)
AORE-IB	Social efficiency	• Assets (A) • Operating expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Average loan balance per Borrower over GNI per capita (in Inverse form) – (I) • Number of borrowers (B)

5. Data

This study utilises data from MiX database for 231 MFIs in three regions: Middle East and North Africa (MENA), East Asia and the Pacific (EAP) and South Asia (SA), in which most IMFIs in MiX mainly operates. Whilst most MFIs in dataset are independent firms operating in their countries/regions, some are local branch of global NGOs or banks, e.g. BRAC and FINCA, or microfinance arm of local banks, e.g. Khushhali Bank in Pakistan. MFIs herein are classified into three schemes: conventional/mainstream, Islamic, and Islamic windows. Islamic window MFIs are MFIs offering both conventional and Islamic microloans. In this research, Islamic and window MFIs are grouped together with IMFIs as they are located in

MENA region where Islamic microloan is their major product albeit offering conventional microloans. Table 4 presents summary of MFI groupings in study.

Table 4: Summary of MFI and classification in study

	MFI Classification															
	Scheme			Age		Profit Orientation		Loan Portfolio Scale			Target Market				MFI Transformation	
	Conventional	Islamic	Islamic Window	Young MFIs	Mature MFIs	Not-For-Profit MFI	For-Profit MFI	Small Scale MFI	Medium Scale MFI	Large Scale MFI	Low End	Broad	High End	Small Business	Unregulated	Regulated
East Asia and the Pacific	63	1	0	10	53	28	35	13	26	24	32	28	1	2	25	38
Middle East and North Africa	29	9	13	22	29	48	3	13	17	21	32	18	0	1	27	24
South Asia	113	4	0	39	78	69	48	25	37	55	97	18	2	0	31	86

All monetary data in dataset are in US Dollars hence comparable. Due to missing data, only balanced data of 2009–2010 is used and statistical summary of data is reported in Table 5.

Table 5: Descriptive statistics of input and output factors, for 231 MFIs & IMFIs

	2009				2010			
	Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation
A	20775	1411363085	39725199.2078	132154162.4625	117332	1698487761	47480227.2294	159036081.9536
O	11717.10	91315191.60	3867480.9178	10295276.6805	35586.80	106325333.84	4683578.7940	11800895.1393
R	0.0000	0.4879	0.0547	0.0794	0.0000	0.5231	0.0545	0.0874
E	9	24021	815.3463	2643.1310	11	22458	907.1429	2723.5451
F	907.87	229911046.55	7850078.2830	23745427.6498	6206.86	269380158.89	9625851.3015	27796662.5509
I	0.3498	53.7634	7.5863	6.0813	0.1912	58.1395	8.1454	6.7017
B	84	6430000	162123.7532	665144.3807	81	6610000	179743.0087	679588.5097

Mean normalization as per Sarkis (2007) is used to standardized the data to avoid "scaling" issues in calculation as magnitude differences between some inputs and outputs are very wide.

$$X_{Norm_{i0}} = X_{i0}\left[\left(\sum_{n=1}^{N} X_{in}\right)N^{-1}\right]^{-1}$$

where X_{i0} is value of ith input of DMU_0, N is the total number of DMU in sample, and $X_{Norm_{i0}}$ is the mean-normalized value of ith input of DMU_0.

Spearman's Rho correlation in Table 6 shows that significantly strong correlations exists between asset, operational expenses, and employee within inputs, and between financial

revenue and borrowers within outputs. These correlations are expected due to inputs and outputs used in this study, i.e. number of employee will have high correlation with operating expenses in inputs and number of borrower may have high correlation with financial revenue collected as outputs. Nevertheless, they are retained in the DEA specification as they are important inputs and outputs in MFI efficiency assessment. These do not necessarily imply causal relationship; DEA algorithm will assign weights to these and maximise them according to their weights. On the contrary, in the presence of high correlations, the use of parametric efficiency measurement method may not be appropriate due to multi-co-linearity problem which makes beta coefficients for correlated independent variables unreliable. The presence of multiple outputs also makes the application of DEA more appropriate in this study.

Table 6: Spearman's Rho Correlations within Inputs and within Outputs

Spearman's Rho Correlations - Within Inputs

	A	O	R	E
A	1.000	.898*	.019	.841*
		.000	.682	.000
O	.898*	1.000	.053	.846**
	.000		.257	.000
R	.019	.053	1.000	.053
	.682	.257		.258
E	.841**	.846**	.053	1.000
	.000	.000	.258	

* = Correlation is significant at the 99% confidence interval

Spearman's Rho Correlations - Within Outputs

	F	I	B
F	1.000	-.046	.812*
		.319	.000
I	-.046	1.000	.266*
	.319		.000
B	.812*	.266*	1.000
	.000	.000	

6. First stage analysis: A DEA approach

Efficiency in 2009 and 2010 for each IMFI is assessed against all MFIs in global frontier, against MFIs in its own regional frontiers and against all IMFIs in Islamic frontier. Analysis herein focuses on VRS output-orientated global frontier results, complemented with result highlights from CRS model, regional frontiers, and Islamic frontier. Thereafter, efficiency scores are plotted into XY scatterplot with social efficiency at X axis and financial efficiency at Y axis to observe MFI positioning regarding these objectives. The XY scatterplot area is divided into four quadrants counter-clockwise: from quadrant I in top right for high social – high financial efficiency quadrant area until quadrant IV in bottom right for high social efficiency – low financial efficiency area.

Based on its theoretical model and mission, it is presumed that Islamic/window MFIs to have higher social efficiency than conventional MFIs whilst more established conventional MFIs to have higher financial efficiency. No presumption is established upon overall efficiency due to it being a mixture of said dual objectives.

Output-oriented DEA Analysis for global frontier

Overall efficiency (AORE-FIB specification): As seen in Table 7, facing 2009 global frontier, Islamic/window MFIs show lower mean of VRS overall efficiency (pure overall efficiency) than conventional MFIs by 75.32% versus 78.24%; a wake-up call for Islamic microfinance proponents. Scale efficiency of MFIs is higher than that of Islamic/window MFIs, i.e. 93.60% versus 92.02%, indicating that conventional MFIs on average were slightly closer to most productive scale size. Thus, these lead to higher mean CRS overall efficiency (global overall efficiency) of conventional MFIs, i.e. 73.02% against 69.10%.

Against 2010 global frontier, Islamic/window MFIs show higher mean VRS overall efficiency than conventional MFIs of 82.48% versus 79.31%, yet slightly lower mean CRS overall efficiency of 75.1% to 75.34% due to lower mean of scale efficiency of 91.29% against 95.03%. High mean scale efficiency in both schemes indicate that, on average, source of inefficiency for MFIs vis-à-vis overall objective in 2009 and 2010 is technical inefficiency, not operational scale. However, lower scale efficiency of Islamic/window MFIs hurt their performance in comparison to conventional MFIs in CRS condition.

First quartile VRS score of Islamic/window MFIs is also lower than conventional MFIs relative to 2009 global frontier, i.e. 51.41% and 65.58%, respectively; though higher at 67.84% to 66.79%, respectively relative to 2010 global frontier. Generally, IMFIs performance compared to MFIs vis-à-vis overall objective raises an alarm for its proponents.

Table 7: Islamic/windows vs Conventional MFIs 2009-10 - VRS global frontier

Islamic/Windows MFIs		2009 Frontier			2010 Frontier		
		Overall Efficiency VRS 09 (AORE-FIB)	Financial Efficiency VRS 09 (AORE-F)	Social Efficiency VRS 09 (AORE-IB)	Overall Efficiency VRS 10 (AORE-FIB)	Financial Efficiency VRS 10 (AORE-F)	Social Efficiency VRS 10 (AORE-IB)
Total		27	27	27	27	27	27
Mean		75.32	65.11	44.71	82.48	73.47	48.04
Std. Error of Mean		4.41	5.19	6.09	3.91	5.38	6.09
Median		84.63	68.60	40.25	87.68	76.94	45.16
Std. Deviation		22.91	26.99	31.62	20.31	27.95	31.62
Skewness		-0.545	-0.460	.669	-0.787	-0.755	.427
Std. Error of Skewness		.448	.448	.448	.448	.448	.448
Minimum		24.55	11.56	2.42	38.87	8.46	3.52
Maximum		100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	51.41	50.12	21.00	67.84	56.98	15.76
	50	84.63	68.60	40.25	87.68	76.94	45.16
	75	96.99	91.02	65.76	100.00	100.00	66.29
Fully Efficient DMU		5	4	3	12	9	4
% of Fully Efficient DMU		18.50	14.80	11.10	44.40	33.30	14.80
DMU with score <50.00		4	6	18	2	5	15
% of DMU with score <50.00		14.80	22.20	66.70	7.40	18.50	55.60

Conventional MFIs		2009 Frontier			2010 Frontier		
		Overall Efficiency VRS 09 (AORE-FIB)	Financial Efficiency VRS 09 (AORE-F)	Social Efficiency VRS 09 (AORE-IB)	Overall Efficiency VRS 10 (AORE-FIB)	Financial Efficiency VRS 10 (AORE-F)	Social Efficiency VRS 10 (AORE-IB)
Total		204	204	204	204	204	204
Mean		78.24	71.28	54.37	79.31	72.94	57.03
Std. Error of Mean		1.23	1.30	2.08	1.22	1.29	2.17
Median		76.95	70.24	53.89	78.84	73.00	58.88
Std. Deviation		17.58	18.53	29.72	17.45	18.45	31.04
Skewness		-0.362	.077	.067	-0.346	-0.096	-.003
Std. Error of Skewness		.170	.170	.170	.170	.170	.170
Minimum		26.53	26.53	3.16	29.47	28.88	3.00
Maximum		100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	65.58	56.85	30.20	66.80	58.79	28.78
	50	76.95	70.24	53.89	78.84	73.00	58.88
	75	97.45	86.92	75.17	100.00	88.58	85.85
Fully Efficient DMU		44	28	28	55	31	40
% of Fully Efficient DMU		21.60	13.70	13.70	27.00	15.20	19.60
DMU with score <50.00		10	23	93	11	22	90
% of DMU with score <50.00		4.90	11.30	45.60	5.40	10.80	44.10

Financial efficiency (AORE-F specification): Consistent to expectation, against 2009 meta-frontier, Islamic/window MFIs have lower mean VRS financial efficiency than conventional MFIs, i.e. 65.11% to 71.28%. Furthermore, Islamic/window MFIs also have lower mean CRS financial efficiency than IMFIs, i.e. 56.26% versus 66.53%, respectively, indicating its general farther distance to optimal scale. Against 2010 global frontier, however, Islamic/windows MFIs marginally outperform conventional MFIs in financial efficiency, i.e. 73.47% to 72.94%

but underperform to MFIs in CRS condition of 61.70 to 67.56%. Conventional MFIs again have higher mean scale efficiency of 93.18% versus 86.76% relative to 2010 global frontier.

In summary, whilst source of financial inefficiency for all MFIs and IMFIs is also technical inefficiency, this is an issue for Islamic/window MFIs that suffer from lower scale efficiency vis-à-vis financial objective compared to conventional MFIs, hurting their CRS efficiency.

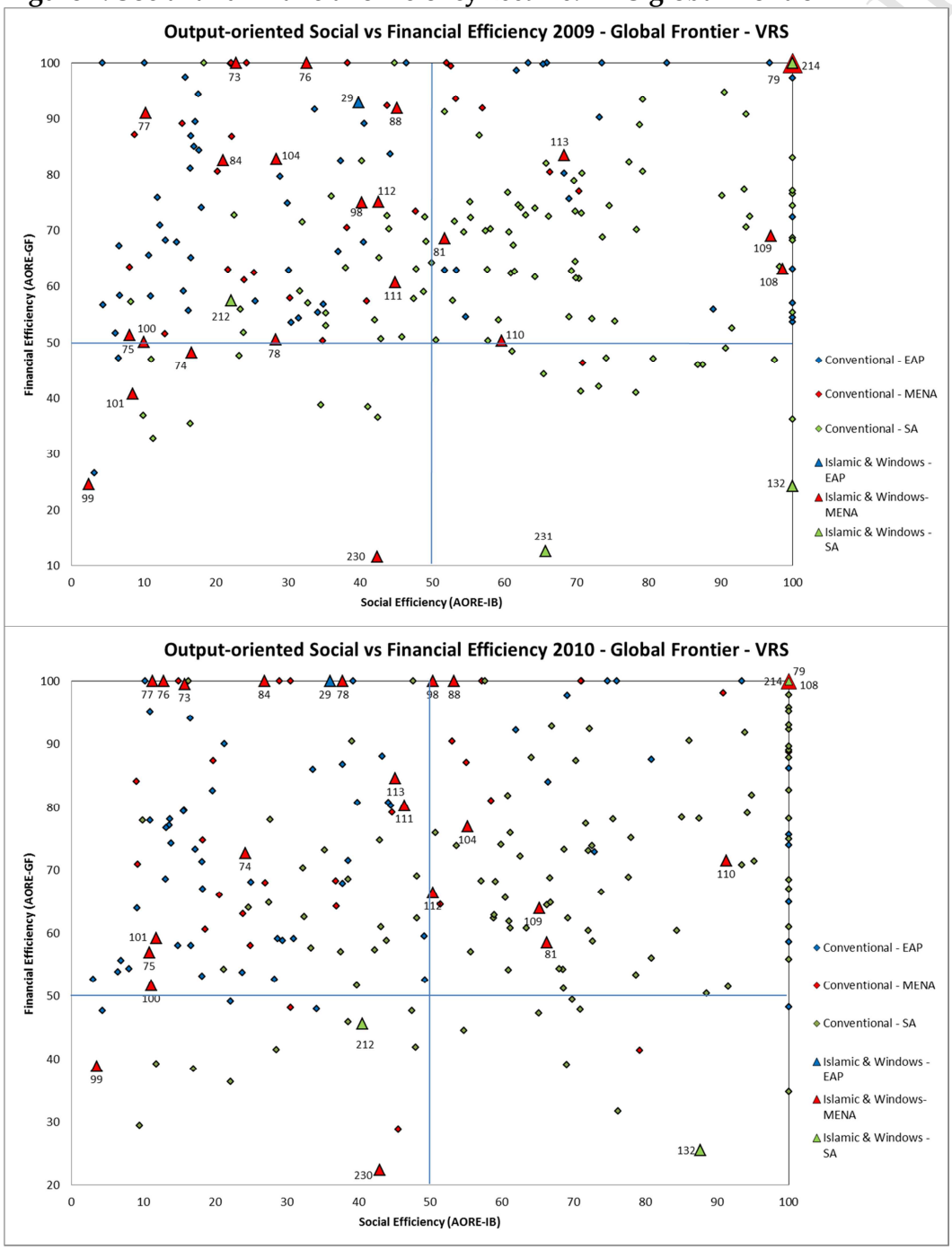
Social Efficiency (AORE-IB Specification): Surprisingly, conventional MFIs outperform IMFIs on mean VRS social efficiency relative to 2009 global frontier, i.e. 54.37% against 44.71%, also marginally higher mean scale efficiency of 81.43% to 80.30%. Moreover, 66.70% of IMFIs scored below 50.00% versus 45.60% of conventional MFIs and lowest VRS score among IMFIs and conventional MFIs are 2.42% and 3.16%, respectively. Against 2010 global frontier, conventional MFIs on average outperform Islamic MFIs with higher mean VRS social efficiency (57.03% to 48.04%) and higher mean scale efficiency (88.85% to 84.18%), albeit lowest social efficiency score among conventional MFIs is 3.00% compared to 3.24% among Islamic/window MFIs.

These results challenge initial expectation that Islamic/window MFIs, to overcome excesses from high interest rates, will outperform conventional MFIs in social efficiency. Lower mean and median VRS social efficiency of Islamic/window MFIs show that their poorer performance are attributable to higher technical inefficiency than conventional MFIs. Additionally, lower mean and median of Islamic/window MFIs' CRS social efficiency demonstrate that lower operational scale compared to conventional MFIs further hurt IMFIs' relative performance.

Social efficiency versus financial efficiency mapping: In Figure 1, 14 out of 27 IMFIs are plotted in quadrant II relative to frontier in 2009 indicating their strategy are leaning toward financial efficiency. Yet, 7 IMFIs are plotted in quadrant I, where 2 IMFIs are fully-efficient in both objectives thus relative balance of dual objectives is feasible. Against 2010 frontier, MFIs spread more evenly in quadrant I and quadrant II. Ten IMFIs are in quadrant I with 3 IMFIs fully-efficient in both objectives.

It should be noted, however, 4 IMFIs and 3 IMFIS are mapped in quadrant III relative to 2009 and 2010 frontiers, respectively due to their low social- and financial efficiency scores. Amongst these, 2 IMFIs are mapped therein relative to both 2009 and 2010 frontiers - Reef Palestine (DMU 99) with its very low social efficiency scores and Al Amal Bank Yemen (DMU 230) with very low financial efficiency score. Thus, further investigation thus needed on their strategy.

Figure 1: Social and financial efficiency 2009-10: VRS global frontier



On the contrary, the biggest IMFI in Pakistan, Akhuwat (DMU 231) are mapped in Quadrant IV in both 2009 and 2010 frontiers; it has high social efficiency scores – even fully efficient relative to 2010 frontiers – but scores very low on financial efficiency. This is because they do not charge any interest or margin to their borrowers; borrowers only repay the amount they borrow without any addition – via Islamic contract called *Qardh Hasan*. Akhuwat cover their entire operation from voluntary donations (Obaidullah & Khan, 2008).

Results from regional and Islamic frontiers

We found the following results from three regional frontiers and Islamic frontier:

East Asia and the Pacific (EAP) frontier: On average, EAP MFIs perform impressively in mean VRS overall efficiency and VRS financial efficiency. Main source of inefficiency for both overall and financial efficiency is generally technical inefficiency in both frontiers. The only IMFI in EAP, AIM Malaysia is fully efficient in both overall and financial efficiency relative to both frontiers and fully scale-efficient in financial efficiency. This confirms the reputation of Malaysia as being the centre of effective Islamic banking and finance, with the best infrastructure in this sector.

However, social efficiency of EAP MFIs on average are mediocre in both frontiers, with mean VRS social efficiency of 57.18% (2009 frontier) and 53.06% (2010 frontier). Since mean social scale efficiency are above 90% in both frontiers, the source of this mediocre performance was generally technical inefficiency; thus penetration strategy needs to be evaluated. AIM Malaysia's social efficiency is above average with 70.76% (2009 frontier) and 67.62% (2010 frontier) albeit mediocre scale efficiency of 64.75% and 67.55%, indicating both technical inefficiency and operational scale problems hereto.

Middle East and North Africa (MENA) regional frontier: Relative to 2009 MENA regional frontier, conventional MFIs have higher mean and median of overall efficiency albeit Islamic/window MFIs having marginally higher overall scale efficiency. Against 2010 frontier, Islamic/window MFIs slightly outperformed conventional MFIs in this measure. Consistent with presumption, conventional MFIs generally outperform Islamic/windows MFI in financial efficiency and in financial scale efficiency in 2009 frontier; yet

Islamic/windows topped them in 2010 frontier with marginally higher mean financial efficiency and mean scale efficiency. A plausible reason suggested thereto was 2010 Moroccan microfinance crisis weakening average of all conventional MFIs, not IMFIs superior performance.

Conversely, conventional MFIs defy initial presumption by outperforming Islamic MFIs in mean and media of social efficiency in both frontiers albeit higher mean social scale efficiency of Islamic/windows MFIs. This, and lower mean and median of overall and financial efficiency, indicate a serious wake-up call for IMFIs in the region that need serious attention thus call for further research.

Generally, technical inefficiency is the major source of inefficiency for overall, financial, and social efficiency for all MFIs, particularly for Islamic MFIs in social efficiency. High mean scale efficiencies indicate that MENA MFIs generally operates closer to optimal scale.

South Asia (SA) regional frontier: Four SA IMFIs in dataset outperformed SA conventional MFIs relative to both frontiers in mean overall efficiency and overall scale efficiency, also by wide margin in mean social efficiency and mean social scale efficiency. Though consistent with initial expectation for social efficiency, these are indeed surprising given longer operation of conventional MFIs.

On the contrary, consistent with presumption, conventional SA MFIs outperform SA IMFIs in mean financial efficiency and mean financial scale efficiency in both frontiers. Wide margin differences of IMFIs scale efficiency from conventional MFIs in both frontiers indicate that Islamic MFIs are relatively farther to optimum scale hence scale problem for IMFIs; show by very low mean CRS financial efficiency of 28.92% to that of 73.32% from conventional MFIs.

Islamic frontier: Relative to own frontiers in both 2009 and 2010, Islamic/windows MFIs generally deliver satisfactory performance in overall, financial, and social efficiency. Majority of IMFIs are located in quadrant I of XY plot map. In both frontiers, mean overall efficiency and mean overall scale efficiency are above 85%, mean financial efficiency and mean financial scale efficiency are above 75%, plus mean social efficiency and mean social

scale efficiency are above 77%; implying technical inefficiency as general source of inefficiency.

Exception thereto being Al Amal Bank Yemen (DMU 230), where scale inefficiency hurt its CRS overall efficiency scores in 2009 for almost 40%. Farz Foundation (DMU 214) also suffers massive financial scale inefficiency. It is fully financial-efficient in both frontiers, yet due to its very small scale efficiency, its CRS financial efficiency scores are only 13.72% (2009 frontier) and 12.33% (2010 frontier). Scale inefficiency also impairs social efficiency performance of Al Mosanid (DMU 74) and TDMN (DMU 79). TDMN was fully-efficient relative to both frontiers under VRS but only scores 36.06% (2009 frontier) and 51.49% (2010 frontier) under CRS, implying very low scale efficiency. Al Mosanid was fully social-efficient relative to 2010 frontier but its low scale efficiency leads to CRS social efficiency score of 57.45%. These may due to unstable political situation in their operation or perception problem regarding product compliance to religious law that barring them from increasing operational scale. Regardless, these deserve further investigation and attention.

7. Second stage analysis: Non-parametric Post DEA Analysis

The main objective of post DEA analysis herein is testing statistical significance of performance differences observed in mean efficiency scores from DEA analysis, i.e. whether different scheme of IMFIs and MFIs significantly affect differences in MFI efficiency in the dataset for 2009-2010. Moreover, we intend to observe several factors which may affect MFI efficiency, i.e. MFI age, operational region (in global frontier), MFI profit orientation, MFI scale of operation, MFI customer targeting and MFI regulation. Non-parametric tests are utilised as post DEA analysis instead of regression analysis due to only two-year period covered herein.

Kruskal-Wallis *H*-test is used to analyse significant influence of aforementioned factors to MFIs performance differences. Since Kruskal-Wallis can only test statistical significance of differences not the *direction* of these differences, Jonckheere-Terpstra test is thereafter utilised as *post hoc* test in analysing whether a trend/pattern existed in median efficiency scores differences. Effect size estimate of this trend, *r*, is also calculated as per Rosenthal (1991:19) with magnitude of *r* is observed using benchmark in Cohen (1988). Jonckheere-

Terpstra test is more meaningful in analysing pattern existence as it uses one-tailed test to observe effects from factors arranged in ranked order, e.g. MFIs are arranged into two ranked scheme groups to observe trend thereto: group 1 of MFIs with stricter scheme (Islamic/windows MFIs) and group 2 of MFIs with more flexible scheme (conventional MFIs), thereby a pattern can be observed from stricter to more flexible MFI scheme.

Since 2009 and 2010 efficiency scores are calculated relative to different frontier, these are not directly comparable. Thus, to make these comparable, efficiency of all MFIs is recalculated using DEA against combined 2009 and 2010 meta-frontier in global, regional, and Islamic frontiers. All MFIs data are therefore combined into 462 DMUs in global frontier assessment, thereby making MFI efficiency scores equally comparable to each other relative to single meta-frontier. Likewise, this method is performed to regional MFIs and Islamic MFIs. However, post DEA analysis on influence of MFI region of operation to efficiency is only done on global frontier as limited EAP and SA IMFI barred this in Islamic meta-frontier. Analysis herein focuses on global frontier with results from other frontiers highlighted thereafter. Post DEA results for global frontier is shown at Table 8[2].

Post DEA analysis I: MFI efficiency vs MFI schemes - global frontier

Post DEA analysis herein observes whether MFI schemes affect MFI efficiency scores. Kruskal-Wallis test is used in testing the statistical significance of median differences between Islamic/window – conventional MFIs and *post hoc* Jonckheere-Terpstra trend test is used to analyse whether trend exist in this differences by arranging MFIs in two groups as mentioned heretofore. As previously, the initial presumption is that Islamic/windows MFIs to have significant edge over conventional in social efficiency whilst conventional MFIs significantly prevail in financial efficiency. The findings are as follow:

- Higher social efficiency of conventional MFIs in VRS and CRS assumptions are found to be statistically significant in meta-frontier approach yet with small effect size of 0.126 (VRS) and 0.122 (CRS); consistent with first phase DEA results but contrasting with initial presumption. Yet, this is only confirmed in CRS input-orientated model.

[2] Post DEA results for global frontier from input-orientated model is presented at Appendix 2 as comparison.

- Consistent to expectation, higher financial efficiency of conventional MFIs are significant under VRS (85% confidence level) and CRS (99% confidence level) albeit small effect size of 0.059 (VRS) and 0.127 (CRS). In input-orientated model, only CRS is significant.
- Islamic/windows MFIs lead in financial efficiency in first phase DEA results relative to 2010 frontier is not found to be significant under meta-frontier approach.
- Pertaining to overall efficiency, conventional MFIs lead over Islamic/window MFIs is only found to be significant under CRS assumption (input- and output-orientated) with very small effect sizes of 0.070.
- Conventional MFIs are found to have significant higher mean scale efficiency with small effect on output-orientated (0.1333) and marginally medium effect on input-orientated (0.276); indicating closer proximity to most productive scale as per expectation.
- In social efficiency, conventional MFIs have significant higher mean scale efficiency (99% confidence level) in input-orientated model with small size of 0.174. Conversely, Islamic/window MFIs are found to have significant higher mean scale efficiency in output-orientated model under meta frontier approach but only on 85% confidence level and with negligible effect size of 0.070.

Post DEA analysis II: MFI efficiency vs MFI region of operation - global frontier

Herewith, regions in observation are arranged in three ranked order according to adoption of microfinance therein from pioneer to late adopter: starting with South Asia, EAP, and finally MENA. Assessment is only performed for global frontier due to aforementioned reason. Initial presumption is that early adopter region to microfinance will have higher financial and social efficiency due to learning curve. The findings are as follow:

- Operational region significantly affect MFI VRS and CRS financial efficiency in both models, where late adopter have higher financial efficiency: MENA followed by EAP then SA, defying initial presumption albeit with small effect sizes (r = 0.12 – 0.18).
- Result above related to technical inefficiency regarding financial objective in early adopter regions because mean financial scale efficiency is actually higher in early adopter region in both models as expected, although with very small effect size of 0.05 – 0.07.
- Operational region also influence VRS and CRS social efficiency significantly consistent with initial presumption in both models: SA have higher social efficiency, followed by

EAP, then MENA. Effect sizes ranging from medium to medium large (0.34 – 0.47) showing advantage as microfinance pioneer region in outreach.

- On overall efficiency, no significant differences of MFI regions on overall efficiency from Kruskal-Wallis test or significant trend from Jonckheere-Terpstra test are found for both models. However, input-orientated model shows trend that regions adopting microfinance earlier have significant higher overall scale efficiency.

Post DEA analysis III: MFI efficiency vs MFI age – global frontier

We reclassified MFI age groups in MiX dataset, i.e. new (1-4 years), young (5-8 years), and mature (8 years plus) into two groups, i.e. group 1 of young MFIs (1-8 years) and group 2 of mature MFIs (above 8 years) due to small number of "new" MFIs. We expect that experience matters – older MFIs to have higher efficiency due to learning curve.

We found that only VRS social efficiency in input-orientated model differs significantly due to MFI age, i.e. young MFIs exhibit higher efficiency scores compared to mature MFIs with very small effect size of 0.064. This result is in contrary to expectation; it may due to the fact that young MFIs are more idealistic and aggressive in its outreach to the poor. Regarding scale efficiency, young MFIs reveal significant higher scale in overall, financial, and social efficiency in output-orientation model, i.e. defying expectation albeit small effect size ranging from 0.085 – 0.097.

Post DEA analysis IV: MFI efficiency vs MFI profit orientation – global frontier

Empirical studies suggested that the Non-Governmental Organisations (NGO)-MFIs to be more efficient (Gutiérrez-Nieto et al., 2007; Haq et al., 2010), especially in social efficiency (Chowdhury & Mukhopadhaya, 2012b). Thus, based on existing literatures, presumption in this study was that not-for-profit MFIs in the dataset to have higher social efficiency and for-profit MFIs to have higher financial efficiency. MFIs are thus ranked as two groups based on their profit motive, moving from not-for-profit to for-profit MFIs.

Similar significant differences due to MFI profit-orientation are found in both models whereby not-for-profit MFIs display higher VRS and CRS overall and social efficiency; with small effect sizes for overall efficiency at 0.147 – 0.165 and small to medium for social

efficiency at 0.234 – 0.24. These results concur with abovementioned studies and presumption regarding social efficiency yet cannot confirm presumption on financial efficiency.

Table 8: Summary Post DEA Analysis: Global Meta-frontier Output-orientated VRS

Output-Oriented All MFIs	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	H-statistic	*J*-statistic	*z*-score	Effect size *r* (if significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
	versus MFI Scheme				versus Region of Operation			
Overall Efficiency	0.598	11726.500	0.773		0.077	33457.500	0.235	
Financial Efficiency	1.588	12177.500****	1.260	0.059	12.016*	38232.000*	3.381	0.157
Social Efficiency	7.297*	13504.500*	2.701	0.126	78.319*	21067.500*	-7.935	-0.369
	versus MFI Age				versus MFI Profit Orientation			
Overall Efficiency	0.973	24022.000	0.987		10.213*	20521.500*	-3.196	-0.149
Financial Efficiency	0.691	23820.500	0.832		0.003	24868.000	-0.052	
Social Efficiency	0.125	23187.000	0.353		26.350*	17824.500*	-5.133	-0.239
	versus MFI Loan Portfolio				versus MFI Target Market			
Overall Efficiency	27.514*	37583.000*	2.457	0.114	36.033*	16719.500*	-5.477	-0.255
Financial Efficiency	43.336*	42684.00*	5.778	0.269	4.887	23686.500	-0.285	
Social Efficiency	16.363*	33405.500	-0.275		210.066*	4265.000*	-14.719	-0.685
	versus MFI Regulation							
Overall Efficiency	10.009*	20226.500*	-3.164	-0.147				
Financial Efficiency	4.834**	21542.000**	-2.199	-0.102				
Social Efficiency	9.671*	20289.500*	-3.110	-0.145				

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval

Post DEA analysis V: MFI efficiency vs MFI loan portfolio – global frontier

Differences in MFI efficiency due to different MFI loan portfolio/scale is assessed herewith by categorising MFIs in dataset into three groups based on gross loan portfolio, i.e. from small scale (less than 2 Million USD), medium scale (2 – 8 Million USD), and large scale (larger than 8 Million USD). The objective is to observe whether MFIs that has managed to grow its portfolio, i.e. termed as "scaling-up", still perform well in terms of social efficiency or shift its focus toward financial efficiency, i.e. existence of "mission drift" (Copestake,

2007a; Mersland & Strøm, 2010). Presumptions herein are MFIs with large portfolio excel in financial efficiency yet MFIs with small portfolio shine in social efficiency. We found that:

- MFI loan scale significantly affects VRS and CRS overall and financial efficiency in both models: as MFI loan portfolio becomes larger its overall and financial efficiency tend to be higher. The effect size, *r*, for overall efficiency is from very small in input-orientated (0.065) to small in output-orientated (0.114). Regarding financial efficiency, the effect size is ranging from small in input-orientated (0.16) to marginally medium (0.269) in output-orientated, thus confirms the presumption.
- We observed significant differences in social efficiency due to loan size based on Kruskal-Wallis test in all models and all assumptions. However, the *direction* trend was only found in VRS input-orientated, i.e. the smaller loan portfolio of an MFI, the higher its social efficiency albeit small effect size (0.11). Thus, if plausible strategy to boost outreach for MFIs is only by reducing inputs, MFIs with smaller loan portfolio can perform more efficiently.

Post DEA analysis VI: MFI efficiency vs MFI target customer – global frontier

This section tests MFI efficiency differences due to different customer targeting based on average loan balance per borrower as percentage of GNI per capita. MFIs are classified into four ranked groups as per customer target in MiX, i.e. low end (maximum 20% of GNI per capita), broad (between 20% - 149% of GNI per capita), high end (between 150% - 250% of GNI per capita), and small business (over 250% of GNI per capita). Thus, trend/pattern existence moving from MFIs targeting on poorest borrowers to those targeting better-off poor can be assessed. Initial presumptions were that social efficiency will be lower but financial efficiency will be higher moving along from MFIs targeting poorest customer to those targeting well-off poor.

Results show that VRS and CRS overall and social efficiency in both models are lower as MFIs shifting its target toward well-off poor. Effect size, *r*, is large for social efficiency (r = 0.504 – 0.684) indicating that shifting target toward better-off customer significantly hurt social efficiency, consistent with expectation. MFIs targeting poorer borrowers are found to have significant higher overall efficiency with small to medium effect size (r = 0.23 – 0.30).

Regarding financial efficiency, significant differences in VRS MFI financial due to MFI client targeting is found in output-orientated model yet ranked trend cannot be established. Nevertheless, MFIs targeting poorer clients are found to have significant higher CRS financial efficiency though with very small effects of 0.068.

Post DEA analysis VII: MFI efficiency vs MFI regulation – global frontier

Many studies focus on the effect of regulating MFI to performance as there has recently been increasing pressure to regulate MFIs in developing countries (Hartarska & Nadolnyak, 2007; Tchakoute-Tchuigoua, 2010). Lafourcade et al. (2005) argued that regulated MFIs have higher efficiency whilst Hartarska & Nadolnyak (2007) observed globally that regulating MFIs does not necessarily warrant better outreach and sustainability, besides deposit-taking authorization. Instead, Haq et al., (2010) asserted that NGO-MFIs, mostly unregulated, are the most efficient under production approach. Therefore, influence of MFI regulation on efficiency is analysed herewith by ranking MFIs in two groups: unregulated and regulated MFIs. Based on literatures, initial presumption is that unregulated MFIs excel in social efficiency due to flexibility whilst regulated MFIs lead in financial efficiency due to deposit-taking authorization.

MFI regulation is found to significantly affect VRS and CRS overall, financial, and social efficiency in both models: efficiency scores are lower should MFIs become regulated albeit small effect size (r = 0.10 – 0.16). These findings confirm presumption in social efficiency but challenge that in financial efficiency. These confirm Hartarska & Nadolnyak (2007) for MFIs in dataset that regulating MFIs do not guarantee higher performance.

Post DEA analysis results from regional and Islamic frontier

Post DEA analysis is also conducted on three regional frontiers and Islamic frontiers.

MFI efficiency vs MFI scheme: (1) Conventional MFIs in MENA meta-frontier exhibit higher VRS overall, financial, and social efficiency plus CRS financial efficiency scores in output-orientated model albeit with small effect size of 0.11 – 0.20; contrasting presumption on social efficiency yet concurring that on financial efficiency. (2) In line with presumption, in both models Islamic MFIs in SA meta-frontier have higher VRS and CRS social efficiency

(very small effects of 0.07 – 0.09) whilst SA conventional MFIs display higher VRS and CRS financial efficiency (small to medium effect size of 0.12 – 0.27).

MFI efficiency vs MFI age: (1) Significant differences due to MFI age is found on VRS overall, financial and social efficiency in EAP meta-frontier for all models whereby younger MFIs tend to have higher efficiency with small to medium effect size. (2) In MENA meta-frontier, significant MFI age influences are found whereby mature MFIs tend to have higher VRS and CRS overall and social efficiency in output-orientated and CRS financial and social efficiency in input-orientated model, confirming presumption. (3) Young MFIs are significantly found to have tendency of higher VRS and CRS financial efficiency for both models in SA meta-frontier; conflicting presumption. (4) Significant findings in Islamic frontier that mature MFIs tend to have higher VRS and CRS social efficiency in output-orientated whilst young MFIs tend to have higher VRS financial efficiency in input-orientated.

MFI efficiency vs MFI profit orientation: (1) Similar significant impact and trend exist in EAP, MENA, SA, and Islamic meta-frontiers for all models whereby not-for-profit MFIs display higher social efficiency as presumed; effect size is large in EAP meta-frontier (r = 0.48 – 0.61), small to medium in Islamic meta-frontier (r = 0.26 – 0.31) yet small in others. (2) Not-for-profit MFIs exhibit significant higher overall efficiency in all models and all condition with medium effect size (r = 0.21 – 0.41). (3) Not-for-profit MFIs display higher financial efficiency in EAP, MENA, and Islamic meta-frontier (small effect size in EAP but medium in the rest) yet mature MFIs reveal high financial efficiency in SA meta-frontier with small effect size.

MFI efficiency vs MFI loan portfolio: (1) Significant differences in overall efficiency due to MFI loan portfolio are observed in all meta-frontiers for all models. However, linear trends can only be established in VRS overall efficiency in EAP meta-frontiers and in CRS overall efficiency in SA meta-frontiers albeit differently; MFIs with smaller loan portfolio exhibit higher scores (small effect size of 0.11 – 0.14) in the former but MFIs with larger loan portfolio display higher scores in the latter (r = 0.083). (2) MFI loan scale also significantly affects financial efficiency for all models in all meta-frontiers, yet patterns are only found in three frontiers: in EAP meta-frontier MFIs with smaller loan portfolio exhibit higher CRS

efficiency for input-orientated model contrasting prediction, whilst in MENA and SA meta-frontiers MFIs with larger loan portfolio have higher VRS and CRS scores in both models as expected. (3) Concurring with presumption, MFIs with smaller loan portfolio tend to have higher VRS and CRS social efficiency in EAP and MENA meta-frontiers.

MFI efficiency vs MFI target market: MFI target market is found to significantly influence overall, financial, and social efficiencies in all meta-frontiers for both models apart from CRS financial efficiency in Islamic meta-frontiers. Yet, significant linear patterns are only observed in the following: (1) VRS and CRS overall efficiency lowered when MFIs shift toward better-off poor in EAP, SA, and Islamic meta-frontiers in all models, with generally small to medium effect size except for Islamic meta-frontier where the effect size is medium (r = 0.28 – 0.34). (2) In MENA meta-frontier, same linear pattern can be established for VRS and CRS output-orientated and CRS input-orientated albeit small effect size (r = 0.12). (3) Contradicting presumption, MFIs shifting toward better-off poor exhibits lower VRS and CRS financial efficiency in SA meta-frontier (small effect size, r = 0.10 – 0.11) in both model, and lower financial efficiency in EAP meta-frontier under VRS (output-orientated) and CRS (both models) though with small effect size. (4) MFIs targeting poorest clients have higher VRS and CRS social efficiency in EAP, MENA, SA, and Islamic meta-frontiers, with mostly large effect size (r = 0.49 – 0.60) except for VRS input-orientated model in MENA and Islamic meta-frontiers where the effect sizes are medium.

MFI efficiency vs MFI regulation: (1) Unregulated MFIs have significantly higher VRS and CRS overall efficiency in EAP, MENA, and Islamic meta-frontiers despite small to medium effect size (r = 0.22 – 0.38) and higher VRS overall efficiency in SA meta-frontier with small effect size of 0.11. (2) Unregulated MFIs exhibits higher VRS and CRS financial efficiency for all models in MENA (small to medium effect size) and Islamic meta-frontiers (medium effect size). (3) Unregulated MFIs also have higher VRS financial efficiency for both models in SA meta-frontier and VRS input-orientated financial efficiency in EAP meta-frontier, though with small effect size. These results confirm presumption on social efficiency and defy that of financial efficiency.

8. Discussions

Our analyses in this study confirm that:

1) Although many MFIs in database have strategy focusing toward outreach (social efficiency) or financial sustainability (financial efficiency) as can be seen in the social-financial efficiency mapping, there exist MFIs that managed to relatively pursue these objectives simultaneously. Thus, instead of focusing on trade-off between these objectives, the focus should be on pursuing them simultaneously by emulating MFIs with similar characteristics that have managed to do so, which is assigned by DEA model as peer benchmark for each MFIs.
2) Islamic/window MFIs in dataset deliver comparable performance with conventional MFIs regarding VRS overall efficiency in global and SA meta-frontiers for both input- and output-orientated models, and in MENA meta-frontier for input-orientated model; yet, due to scale inefficiency, conventional MFIs outperform Islamic/window MFIs in term of CRS overall efficiency in global meta-frontier.
3) Nevertheless, Islamic/window MFIs still generally cannot match conventional MFIs in financial efficiency in VRS and CRS financial efficiency in global, MENA, and SA meta-frontiers in both models, except for VRS input-orientated model in global and MENA regional where they can display comparable performance with conventional MFIs.
4) a) Moreover, Islamic/window MFIs in dataset still generally cannot match conventional MFIs' social efficiency performance relative to global and MENA meta-frontiers under output-orientated model, contrasting with presumption. Islamic/window MFIs indeed outperform conventional MFIs in social efficiency for SA meta-frontier for both DEA models as per initial presumption yet the effect size is almost negligible, i.e. 0.07 – 0.09, whilst conventional MFIs surpassed them in global and MENA meta-frontiers with relatively bigger effect size (r = 0.12 in global frontier and r = 0.11 – 0.20 in MENA frontier).

   b) Islamic/window MFIs can only match conventional MFIs performance in MENA meta-frontier under input-orientated model, i.e. if the feasible strategy for MFIs is to minimise inputs to boost efficiency. This is indeed a wake-up call for proponents of IMFIs to rectify this matter since (1) improving conventional MFIs in outreach to the poorest by eliminating high interest rates is *raison d'être* of Islamic microfinance; (2) most Islamic/window MFIs are located in MENA region, whilst there are only four

Islamic/window MFIs in SA region so the results from MENA region can be seen as more closer to reality; (3) Naturally, most likely strategy undertaken by microfinance units is output-orientated, i.e. maximising outputs in the face of scarce resources. This indeed warrants further research.

5) The major source of inefficiency observed for both conventional and Islamic/windows MFIs in 2009 – 2010 is generally technical inefficiency. Thus, MFIs are encouraged to re-evaluate their strategy concerning dual objectives by emulating best practice MFIs' assigned by DEA as their benchmark to increase efficiency.

6) Significant regional effect to MFI efficiency relative to global frontier is observed as follow: MFIs in region with earlier microfinance adoption generally have found suitable scale and strategy to penetrate deeper into poorest borrowers hence higher mean social efficiency. MFIs in region with relatively nascent microfinance operation may still have learning curve in increasing their penetration. Otherwise, these may show different customer targeting as per Diop et al. (2007), i.e. MFIs targeting entrepreneurial poor (or well-off poor) instead of absolute poor in region with relatively newer microfinance operation may have caused opposite trend in financial efficiency. This needs further qualitative investigation.

7) a) We found that in global meta-frontier MFI age does not have significant effect over VRS and CRS overall and financial efficiency in both models and also VRS social efficiency in output-orientated. Young MFIs are indeed found to have significantly higher VRS social efficiency in input-orientated model, albeit negligible effect size at 0.064. Thus, in general we confirm Gutiérrez-Nieto et al. (2009) that MFI age does not affect efficiency in global frontier.

   b) Nevertheless, results are different in regional scope: in EAP meta-frontier, young MFIs exhibit higher VRS overall, financial, and social efficiency scores whilst in SA meta-frontiers they display higher financial efficiency, which challenges initial presumption that positive relationship exists between MFI efficiency and age. This may due to aggressive fresh strategy of young MFIs in expanding operation thus confirming Nghiem et al. (2006) that young MFIs tend to have higher efficiency in EAP region.

c) On the contrary, mature MFIs have higher VRS and CRS overall and social efficiency (output-orientated) and CRS financial and social efficiency (input-orientated) in MENA meta-frontier, indicating that attaining efficiency therein generally takes time due to various reasons, e.g. political condition, product knowledge dissemination, perception on religious compliance, and other factors requiring further analysis. The same trend is observed for output-orientated VRS and CRS social efficiency in Islamic meta-frontier. Thus, this study cannot confirm Abdelkader et al. (2012) who asserted that young MFIs have higher efficiency in MENA region, whilst it partly support Hermes & Lensink (2011) in Islamic meta-frontier that financial sustainability is attained by mature MFIs, yet only when strategy that can be undertaken to boost efficiency is by minimising inputs.

8) a) We found that not-for-profit MFIs generally have significant higher social efficiency for both models in all meta-frontiers analysed as per expectation. Not-for-profit MFIs also exhibit higher overall efficiency in all meta-frontiers except for SA meta-frontiers.

b) Although for-profit MFIs display significant higher financial efficiency in SA meta-frontiers, yet the effect size is negligible at 0.10 – 0.15. Moreover, in most other frontiers excluding global meta-frontiers and VRS output-orientated model in EAP meta-frontier, not-for-profit MFIs prevails herein with small and medium effect size thereby defying presumption.

c) Thus, in general we concur with studies suggesting not-for-profit MFIs as the best provider of microfinance, e.g. Dichter (1996), Haq et al. (2010), and Ahmed (2002), whilst cannot confirm Tchakoute-Tchuigoua (2010) that for-profit MFIs outperform not-for-profit MFIs in social efficiency.

9) a) We observed that MFI loan scale portfolio has significant impact to almost all overall, financial and social efficiency in all meta-frontiers, although not all can show significant linear direction trends. Nevertheless, where they do, MFIs that have smaller loan portfolio exhibit higher social efficiency and MFIs with larger loan portfolio display higher financial efficiency as per presumption. Exception for these is in EAP meta-frontier in input-orientated whereby smaller portfolio MFIs exhibit higher VRS financial efficiency albeit with small effect size.

b) Regarding overall efficiency, trend observed are mixed: MFIs having larger loan portfolio prevails in global and SA meta-frontiers, whilst overall efficiency score show higher trend in MFIs with smaller loan portfolio in EAP meta-frontier. Interestingly, in SA and Islamic meta-frontiers MFIs with smaller loan and larger loan portfolio display comparable social efficiency performance.

c) Thus, we can argue that due to scaling-up, MFIs in global, MENA and SA meta-frontiers tend to lean more toward financial sustainability. However, we concur with Armendariz & Szafarz (2011) that it may be too early to judge an existence of mission drift only from total loan portfolio, since a large loan portfolio may consists of many small loans, this fact worth further investigation. Moreover, we hereby cannot argue that MFIs with smaller loan portfolio tend to have higher social efficiency, since in several meta-frontiers MFIs with smaller loan portfolio have comparable social efficiency with those with larger loan portfolio.

10) a) MFI customer targeting significantly affect overall, financial and social efficiency in almost all frontiers in all models except for financial efficiency in global and Islamic meta-frontiers. Although not all can be established, we observed similar linear trend in most relationship where MFIs targeting poorer borrowers to have higher overall and social efficiency in all meta-frontiers, with exceptionally large effect size for social efficiency in all but Islamic meta-frontiers.

b) Regarding financial efficiency, comparable performance between MFIs targeting different customer are found in most meta-frontiers. Yet, interestingly, we found that MFIs targeting poorer borrowers also exhibits higher financial efficiency in SA meta-frontier (all models) and also in global and EAP meta-frontiers (all model CRS), though all with small effect size. Results in the latter two frontiers show that if MFIs are operating in their optimal scale size, MFIs focusing poorer borrower will excel in financial efficiency.

c) These results demonstrate that firstly, targeting better-off customers with larger loan amount do not necessarily result in higher financial and overall efficiency. Secondly, MFIs focusing on the poorer borrower can also demonstrate comparable financial efficiency with MFIs targeting well-off borrower. We thereby argue that MFIs can have more impact by focusing on the poorest of the poor. We also confirm Copestake

(2007b) that MFIs in dataset that deliberately target well-off poor tend to have lower outreach.

11) a) We observed that unregulated MFIs have higher overall, financial and social efficiency in all but social efficiency in SA meta-frontiers. We thereby confirm Haq et al. (2010) and Gutiérrez-Nieto et al. (2009), who suggested that unregulated MFIs to be the best provider for microfinance, and Hartarska and Nadolnyak (2007), who stated that MFI transformation may not necessarily lead to better outreach and sustainability. Likewise, these cannot concur with Lafourcade et al. (2005), that regulated MFIs to have higher efficiency, and Tchakoute-Tchuigoua (2010), that regulated for-profit MFIs have better social efficiency than unregulated MFIs.

b) Secondly, the policy implication of these results is to recommend relevant authorities to formulate special regulatory framework for MFI as it has distinct features than traditional banking system so as not to overly restrict MFIs flexibility and ability to increase its efficiency in its operation.

9. Conclusion and Direction for Future Research

Apart from EAP meta-frontier, Islamic/windows MFIs in the dataset deliver comparable performance with conventional MFIs in terms of pure overall, financial and social efficiency for input-orientated model in global and MENA meta-frontiers, pure social efficiency for both models in SA meta-frontier, and also overall efficiency for output-orientated in global meta-frontier. Islamic/window MFIs even outperform conventional MFIs in social efficiency for both models in SA meta-frontier. This is great news for Islamic/windows MFIs proponents, giving empirical evidence that investment of time, efforts and funds onto formulising and operating stricter microfinance scheme results in generally equivalent performance to conventional MFIs.

However, conventional MFIs surpassed Islamic/window MFIs in financial and social efficiency under output-orientated strategy in global, EAP and SA meta-frontiers, in pure overall efficiency in MENA meta-frontiers, and in financial efficiency under input-orientated in SA meta-frontier. These findings should serve as warning to IMFIs and their proponents considering that, firstly, microfinance providers will naturally strive for output-orientated

strategy in order to maximise outputs, i.e. dual objectives, with the constraint of limited input resources; thus findings that show conventional MFIs still outshone them in these strategy should motivate Islamic/window MFIs to improve their performance in regard to this strategy. Secondly, most of Islamic/windows MFIs are currently located in MENA region so relatively inferior performance in this region should drive them to perform better in the future. Thirdly, even where IMFIs show comparable performance in overall efficiency in global meta-frontier for both models and in financial efficiency in global and MENA meta-frontiers under input-orientated, conventional MFIs outperform them in CRS efficiency due to relative scale efficiency superiority; IMFIs thereby should do hard work to improve their operation to go closer to the optimal production scale size.

In summary, further detail regional or within-country research is needed to assess Islamic/ windows MFIs in the future, given limited number of IMFIs in this research. This study thereby serves to provide preliminary efficiency assessment in global IMFI performance against its conventional counterparts; which is still lacking in literature. Various reasons may underlie these results that warrant further analysis in the future, e.g. larger balanced dataset needed, *in situ* erosion in scheme implementation (agency problem) or different customer targeting (entrepreneurial poor versus absolute poor). This study also found several factors that influence MFIs efficiency that need attention for policy recommendation. Further study expects to refine DEA specification and modelling, complemented by qualitative field research.

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Appendix 1
Summary Post DEA Analysis: Global Meta-frontier Input-orientated VRS

Input-Oriented All MFIs	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if significant)	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)
	versus MFI Scheme				**versus Region of Operation**			
Overall Efficiency	0.113	10706.500	-0.337		0.413	33971.500	0.575	
Financial Efficiency	0.004	10955.500	-0.066		15.549*	39055.500*	3.924	0.183
Social Efficiency	0.288	11510.500	0.537		66.278*	22143.500*	-7.226	-0.336
	versus MFI Age				**versus MFI Profit Orientation**			
Overall Efficiency	0.266	23401.000	0.516		12.572*	20037.500*	-3.546	-0.165
Financial Efficiency	0.004	22637.500	-0.062		0.868	23648.000	-0.932	
Social Efficiency	1.907	20893.000***	-1.381	-0.064	26.543*	17798.500*	-5.152	-0.240
	versus MFI Loan Portfolio				**versus MFI Target Market**			
Overall Efficiency	24.131*	35974.500***	1.405	0.065	31.014*	17386.000*	-4.980	-0.232
Financial Efficiency	28.547*	39086.000*	3.430	0.160	6.409***	23326.000	-0.553	
Social Efficiency	22.671*	30126.000*	-2.416	-0.112	118.403*	9510.000*	-10.821	-0.503
	versus MFI Legal Regulation							
Overall Efficiency	9.646*	20306.000*	-3.106	-0.144				
Financial Efficiency	7.428*	20817.000*	-2.726	-0.127				
Social Efficiency	6.509**	21058.000*	-2.551	-0.119				

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval

Appendix 2
Summary Post DEA Analysis: Global Meta-frontier CRS

All MFIs CRS	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if significant)	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)
	versus MFI Scheme				**versus Region of Operation**			
Overall Efficiency	2.244****	12396.500***	1.498	0.070	0.262	32385.000	-0.473	
Financial Efficiency	7.483*	13538.000*	2.735	0.127	8.242**	37030.000*	2.588	0.120
Social Efficiency	6.873*	13433.000*	2.622	0.122	95.306*	19193.500*	-9.164	-0.426
	versus MFI Age				**versus MFI Profit Orientation**			
Overall Efficiency	0.165	23258.000	0.407		9.982*	20559.500*	-3.159	-0.147
Financial Efficiency	0.109	23158.000	0.331		0.087	25348.500	0.294	
Social Efficiency	0.042	22991.500	0.205		25.261*	17968.000*	-5.026	-0.234
	versus MFI Loan Portfolio				**versus MFI Target Market**			
Overall Efficiency	7.763**	35408.500****	1.031	0.048	41.591*	15328.500*	-6.495	-0.302
Financial Efficiency	24.638*	41352.000*	4.907	0.228	3.195	22082.000*	-1.476	-0.069
Social Efficiency	13.466*	32722.000	-0.721		195.771*	4970.500*	-14.184	-0.660
	versus MFI Legal Regulation							
Overall Efficiency	12.380*	19726.000*	-3.519	-0.164				
Financial Efficiency	8.593*	20532.000*	-2.931	-0.136				
Social Efficiency	7.397*	20823.500*	-2.720	-0.127				

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval

Table 1

Inputs	Initial	Definition	Usage in literatures	Unit
Assets	A	Total wealth available to MFI from capital and borrowings for its transformation process. It is used as inputs to represent capital for production approach.	Bassem (2008), Kipesha (2012) and Gutierrez-Nieto et al. (2009)	USD '000
Operating Expense	O	Expenses related to operations, e.g. all personnel expense, depreciation and amortization, and administrative expense. It is used as input in production approach since production process will not be viable in the long run if outputs were produced at high costs hence need to be managed to avoid waste.	Gutiérrez-Nieto et al. (2007), Gutiérrez-Nieto et al. (2009), Hassan and Sanchez (2009) and Athanassopoulos (1997)	USD '000
Portfolio at Risk 30 days	R	Percentage of total loan outstanding at risk of default by having one or more principal or instalments in arrears more than 30 days. This variable is used herein as input in production approach to represent risk in transformation process as less risk is favourable for the firm.	As far as we concerned, it has not been used as input in other DEA – microfinance literatures.	%
Employee	E	Labour input, i.e. all individuals employed by MFI, including contract employees or advisor whether or not listed on MFI employee roster	Athanassopoulos (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Kipesha (2012), and Haq et al. (2010)	Numeric

Table 2

Outputs	Initial	Definition	Usage in literatures	Unit	MFI Objective (Efficiency) Represented
Financial Revenue	F	Revenue from loan portfolio, including margin rate charged in Islamic microfinance loan. It is used as output in production approach and proxy for s*ustainability* since an MFI that cannot collect enough revenue will not be viable to operate in the long run by itself	Gutiérrez-Nieto et al. (2009) and Hassan & Sanchez (2009).	USD '000	Sustainability (Financial Efficiency)
Inverse of Average Loan Borrower	I	Inverse format of average loan balance per MFI borrowers, which is a widely used proxy to measure *depth of outreach* ; standardized over gross national income (GNI) per capita to remove currency & purchasing power parity difference. Usage of inverse format so as to have characteristic as output where larger value means better.	Modification from literatures. Gutiérrez-Nieto et al. (2009) use average loan borrower as index with number of borrower whilst we use them separately.	%	Outreach (Social Efficiency)
Borrowers	B	the number of individual or entity who currently has outstanding loan balance with MFIs or is primarily responsible for repaying any portion of the Gross Loan Portfolio. Herein, it is used an output to resemble the *breadth of outreach* .	Modification from literatures. Most literatures use number of women borrowers, e.g. Cull et al. (2007) and Nghiem et al. (2006).	Numeric	Sustainability (Financial Efficiency)

DEA specifications	Efficiency represented	Inputs variables	Outputs variables
AORE-FIB	Overall efficiency	• Assets (A) • Operating expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Financial revenue (F) • Average loan balance per Borrower over GNI per capita (in Inverse form) – (I) • Number of borrowers (B)
AORE-F	Financial efficiency	• Assets (A) • Operating Expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Financial revenue (F)
AORE-IB	Social efficiency	• Assets (A) • Operating expenses (O) • Portfolio at risk 30 days (R) • Employees (E)	• Average loan balance per Borrower over GNI per capita (in Inverse form) – (I) • Number of borrowers (B)

	MFI Classification															
	Scheme			Age		Profit Orientation		Loan Portfolio Scale			Target Market				MFI Transformation	
	Conventional	Islamic	Islamic Window	Young MFIs	Mature MFIs	Not-For-Profit MFI	For-Profit MFI	Small Scale MFI	Medium Scale MFI	Large Scale MFI	Low End	Broad	High End	Small Business	Unregulated	Regulated
East Asia and the Pacific	63	1	0	10	53	28	35	13	26	24	32	28	1	2	25	38
Middle East and North Africa	29	9	13	22	29	48	3	13	17	21	32	18	0	1	27	24
South Asia	113	4	0	39	78	69	48	25	37	55	97	18	2	0	31	86

	2009				2010			
	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
A	20775	1411363085	39725199.2078	132154162.4625	117332	1698487761	47480227.2294	159036081.9536
O	11717.10	91315191.60	3867480.9178	10295276.6805	35586.80	106325333.84	4683578.7940	11800895.1393
R	0.0000	0.4879	0.0547	0.0794	0.0000	0.5231	0.0545	0.0874
E	9	24021	815.3463	2643.1310	11	22458	907.1429	2723.5451
F	907.87	229911046.55	7850078.2830	23745427.6498	6206.86	269380158.89	9625851.3015	27796662.5509
I	0.3498	53.7634	7.5863	6.0813	0.1912	58.1395	8.1454	6.7017
B	84	6430000	162123.7532	665144.3807	81	6610000	179743.0087	679588.5097

Table 6

Spearman's Rho Correlations - Within Inputs

	A	O	R	E
A	1.000	.898*	.019	.841*
		.000	.682	.000
O	.898*	1.000	.053	.846**
	.000		.257	.000
R	.019	.053	1.000	.053
	.682	.257		.258
E	.841**	.846**	.053	1.000
	.000	.000	.258	

* = Correlation is significant at the 99% confidence interval (2-

Spearman's Rho Correlations - Within Outputs

	F	I	B
F	1.000	-.046	.812*
		.319	.000
I	-.046	1.000	.266*
	.319		.000
B	.812*	.266*	1.000
	.000	.000	

Islamic & Conventional Global Meta Frontier Output-orientated VRS Only

Islamic/Windows MFIs		2009 Frontier			2010 Frontier		
		Overall Efficiency VRS 09 (AORE-FIB)	Financial Efficiency VRS 09 (AORE-F)	Social Efficiency VRS 09 (AORE-IB)	Overall Efficiency VRS 10 (AORE-FIB)	Financial Efficiency VRS 10 (AORE-F)	Social Efficiency VRS 10 (AORE-IB)
Total		27	27	27	27	27	27
Mean		75.32	65.11	44.71	82.48	73.47	48.04
Std. Error of Mean		4.41	5.19	6.09	3.91	5.38	6.09
Median		84.63	68.60	40.25	87.68	76.94	45.16
Std. Deviation		22.91	26.99	31.62	20.31	27.95	31.62
Skewness		-0.545	-0.460	.669	-0.787	-0.755	.427
Std. Error of Skewness		.448	.448	.448	.448	.448	.448
Minimum		24.55	11.56	2.42	38.87	8.46	3.52
Maximum		100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	51.41	50.12	21.00	67.84	56.98	15.76
	50	84.63	68.60	40.25	87.68	76.94	45.16
	75	96.99	91.03	65.76	100.00	100.00	66.29
Fully Efficient DMU		5	4	3	12	9	4
% of FullyEfficient DMU		18.50	14.80	11.10	44.40	33.30	14.80
DMU with score <50.00		4	6	18	2	5	15
% of DMU with score <50.00		14.80	22.20	66.70	7.40	18.50	55.60

Conventional MFIs		2009 Frontier			2010 Frontier		
		Overall Efficiency VRS 09 (AORE-FIB)	Financial Efficiency VRS 09 (AORE-F)	Social Efficiency VRS 09 (AORE-IB)	Overall Efficiency VRS 10 (AORE-FIB)	Financial Efficiency VRS 10 (AORE-F)	Social Efficiency VRS 10 (AORE-IB)
Total		204	204	204	204	204	204
Mean		78.24	71.28	54.37	79.31	72.84	57.03
Std. Error of Mean		1.23	1.30	2.08	1.22	1.29	2.17
Median		76.95	70.24	53.89	78.84	73.00	58.88
Std. Deviation		17.58	18.53	29.72	17.45	18.45	31.04
Skewness		-0.362	.077	.067	-0.346	-0.096	-.003
Std. Error of Skewness		.170	.170	.170	.170	.170	.170
Minimum		26.53	26.53	3.16	29.47	28.88	3.00
Maximum		100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	65.58	56.85	30.20	66.80	58.79	28.78
	50	76.95	70.24	53.89	78.84	73.00	58.88
	75	97.45	86.92	75.17	100.00	88.58	85.85
Fully Efficient DMU		44	28	28	55	31	40
% of FullyEfficient DMU		21.60	13.70	13.70	27.00	15.20	19.60
DMU with score <50.00		10	23	93	11	22	90
% of DMU with score <50.00		4.90	11.30	45.60	5.40	10.80	44.10

Table 8
Summary Post DEA Analysis: Global Meta-frontier Output-orientated VRS

Output-Oriented All MFIs	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)
	versus MFI Scheme				**versus Region of Operation**			
Overall Efficiency	0.598	11726.500	0.773		0.077	33457.500	0.235	
Financial Efficiency	1.588	12177.500****	1.260	0.059	12.016*	38232.000*	3.381	0.157
Social Efficiency	7.297*	13504.500*	2.701	0.126	78.319*	21067.500*	-7.935	-0.369
	versus MFI Age				**versus MFI Profit Orientation**			
Overall Efficiency	0.973	24022.000	0.987		10.213*	20521.500*	-3.196	-0.149
Financial Efficiency	0.691	23820.500	0.832		0.003	24868.000	-0.052	
Social Efficiency	0.125	23187.000	0.353		26.350*	17824.500*	-5.133	-0.239
	versus MFI Loan Portfolio				**versus MFI Target Market**			
Overall Efficiency	27.514*	37583.000*	2.457	0.114	36.033*	16719.500*	-5.477	-0.255
Financial Efficiency	43.336*	42684.00*	5.778	0.269	4.887	23686.500	-0.285	
Social Efficiency	16.363*	33405.500	-0.275		210.066*	4265.000*	-14.719	-0.685

	versus MFI Regulation			
Overall Efficiency	10.009*	20226.500*	-3.164	-0.147
Financial Efficiency	4.834**	21542.000**	-2.199	-0.102
Social Efficiency	9.671*	20289.500*	-3.110	-0.145

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval

Appendix 1
Summary Post DEA Analysis: Global Meta-frontier Input-orientated VRS

Input-Oriented All MFIs	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)
	versus MFI Scheme				**versus Region of Operation**			
Overall Efficiency	0.113	10706.500	-0.337		0.413	33971.500	0.575	
Financial Efficiency	0.004	10955.500	-0.066		15.549*	39055.500*	3.924	0.183
Social Efficiency	0.288	11510.500	0.537		66.278*	22143.500*	-7.226	-0.336
	versus MFI Age				**versus MFI Profit Orientation**			
Overall Efficiency	0.266	23401.000	0.516		12.572*	20037.500*	-3.546	-0.165
Financial Efficiency	0.004	22637.500	-0.062		0.868	23648.000	-0.932	
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	versus MFI Loan Portfolio				**versus MFI Target Market**			
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	versus MFI Legal Regulation							
Overall Efficiency	9.646*	20306.000*	-3.106	-0.144				
Financial Efficiency	7.428*	20817.000*	-2.726	-0.127				
Social Efficiency	6.509**	21058.000*	-2.551	-0.119				

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval

Appendix 2
Summary Post DEA Analysis: Global Meta-frontier CRS

All MFIs CRS	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra		
	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)	***H*-statistic**	***J*-statistic**	***z*-score**	**Effect size *r*** (if *J* significant)
	versus MFI Scheme				**versus Region of Operation**			
Overall Efficiency	2.244****	12396.500***	1.498	0.070	0.262	32385.000	-0.473	
Financial Efficiency	7.483*	13538.000*	2.735	0.127	8.242**	37030.000*	2.588	0.120
Social Efficiency	6.873*	13433.000*	2.622	0.122	95.306*	19193.500*	-9.164	-0.426
	versus MFI Age				**versus MFI Profit Orientation**			
Overall Efficiency	0.165	23258.000	0.407		9.982*	20559.500*	-3.159	-0.147
Financial Efficiency	0.109	23158.000	0.331		0.087	25348.500	0.294	
Social Efficiency	0.042	22991.500	0.205		25.261*	17968.000*	-5.026	-0.234
	versus MFI Loan Portfolio				**versus MFI Target Market**			
Overall Efficiency	7.763**	35408.500****	1.031	0.048	41.591*	15328.500*	-6.495	-0.302

Financial Efficiency	24.638*	41352.000*	4.907	0.228	3.195	22082.000*	-1.476	-0.069
Social Efficiency	13.466*	32722.000	-0.721		195.771*	4970.500*	-14.184	-0.660
	versus MFI Legal Regulation							
Overall Efficiency	12.380*	19726.000*	-3.519	-0.164				
Financial Efficiency	8.593*	20532.000*	-2.931	-0.136				
Social Efficiency	7.397*	20823.500*	-2.720	-0.127				

* = significant at 99% confidence interval, ** = significant at 95% confidence interval, *** = significant at 90% confidence interval, and **** = significant at 85% confidence interval