EFFICIENCY AND PRODUCTIVITY ANALYSIS OF

GLOBAL NOT-FOR-PROFIT

MICROFINANCE INSTITUTIONS

DATA ENVELOPMENT ANALYSIS APPROACH

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Microfinance has been regarded as the one of the effective solutions in poverty alleviation efforts globally. Its growth has been driven by not-for-profit microfinance institutions in the form of non-governmental organization, credit unions, cooperatives and others. Microfinance sits at the unique position between social welfare programme and financial institutions as it faces dual objectives of outreach to the poor and financial sustainability. Due to its unique dual objectives, it is imperative to undertake a comprehensive performance and productivity assessment as microfinance institutions currently hold an important roles in improving the lives of the poor globally.

This thesis thus has multi-faceted objectives: firstly, it seeks to propose a comprehensive performance measurement that can evaluate these objectives comprehensively, as opposed to current focus on trade-offs between microfinance dual objectives and short-sighted focus on financial indicator, yet proficient to track microfinance performance and total factor productivity over time. It therefore proposes Data Envelopment Analysis (DEA) as adept measurement for microfinance institutions globally, especially using hyperbolic, non-oriented DEA model due to its benchmarking capability and DEA-based Circular Malmquist Index in measuring total factor productivity under condition of unbalanced data, such as the case with microfinance. This thesis also proposes Social-Financial Efficiency Matrix as a performance monitoring tool for microfinance.

Secondly, this thesis seeks to provide thought-provoking empirical evidence to the performance comparison between Islamic and conventional microfinance. Thirdly, it seeks to explore the relationship between loan methodology and microfinance efficiency in six different regions globally, in contributing to the search of an adept loan method that can boost efficiency. Fourthly, it seeks to analyse microfinance productivity globally in times of crisis, i.e. evaluating its resilience toward external shocks, so that improvement can be proposed for the future.

Keywords: Data Envelopment Analysis, Circular Malmquist Index, Hyperbolic Non-oriented DEA, Efficiency, Microfinance

This thesis is dedicated as my devotion to Allaah *subhaanahu wa ta'ala*

It is also dedicated to my wife, Lili Lengkana,

my children: Muhammad Fawwaz Abdullah and Muhammad Syafiq Abdurrahman,

my mother, Geraldina Muhidin,

and to the memory of my late father, Muhidin *rahimahullaah*.

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List of Abbreviation

AE	Allocative Efficiency
ATC	Average Total Cost
BC	Battese and Coelli
BCC	Bankers, Charnes, and Cooper
BMT	Baitul Maal wat Tamwil
CCR	Charnes, Cooper, and Rhodes
CE	Overall Cost Efficiency
CES	Constant Elasticity of Substitution
CGAP	Consultative Group to Assist the Poor
CMI	Circular Malmquist Index
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DEA-MFI	DEA-based Microfinance Institution study
DFA	Distribution-Free Analysis
DMU	Decision Making Units
DRS	Decreasing Return to Scale
EAP	East Asia and the Pacific
EC	Efficiency Change
EECA	Eastern Europe and Central Asia
FGNZ	Färe, Grosskopf, Norris, and Zhang
FINCA	Foundation for International Community Assistance
GNI	Gross National Income
IMFI	Islamic Microfinance Institution
IRS	Increasing Return to Scale

JLMS	Jondrow, Lovell, Materov, and Schmidt
LAC	Latin America and the Caribbean
MC	Marginal Cost
MDG	Millennium Development Goals
MENA	Middle East and North Africa
MFI	Microfinance Institution
MI	Malmquist Index
MIX Market	Microfinance Information Exchange Market (database)
MLE	Maximum Likelihood Estimation
MPSS	Most Productive Scale Size
MSC	Meta-Scale Efficiency Change
MSE	Meta-Scale Efficiency
NGO	Non-Governmental Organisation
NGO-MFI	NGO-based Microfinance Institution
OLS	Ordinary Least Squares
PEC	Pure Efficiency Change
RD	Ray and Desli
ROI	Return on Investment
SA	South Asia
SE	Scale Efficiency
SEC	Scale Efficiency Change
SFA	Stochastic Frontier Analysis
TC	Technological Change or Boundary Shift
TE	Technical Efficiency
TFA	Thick Frontier Analysis

TGC	Technological Gap Change
TGC^{VRS}	Technological Gap Change under VRS
TGV	Tecnological Gap under VRS
TOPS	Technically Optimal Productive Scale
VRS	Variable Return to Scale

Chapter I: Introduction

I.1. Microfinance: An Introduction

I.1.1. Microfinance and Millennium Development Goals

Poverty alleviation has become focal point in the development programme of many countries since 1970s (Dichter, 1996). In further boosting this effort, United Nations placed poverty alleviation as one of its central objectives in Millennium Development Goals (MDG) in 2000, wherein halving the 1990 global poverty rate of 41.6% by 2015 is one of its goals (Diop et al., 2007; Mahjabeen, 2008). However, Chen and Ravallion (2010) observed that, even though the percentage of developing countries' population living below $1.25 per day was already halved from 52% to 25% over the period of 1981-2005 thus projecting remarkable decline of the poverty rate of 16.6% in 2015, most of this decline was attributed to China's remarkable success in its absolute poverty eradication programme. Excluding China from the calculation, the percentage of developing countries' population living below $1.25 per day in the same period only falls from 40% to 28%; a rate of fall less than half the trend including China. Projected poverty level for developing countries excluding China in 2015 is 25.1% from 35% in 1990. This indicates that developing countries outside of China is not on track to achieve MDG goals of halving poverty, thus more robust efforts need to be undertaken by to meet this goal.

One of the solutions prescribed in global poverty alleviation effort over the past three decades is microfinance (Koveos & Randhawa, 2004; Shaw, 2004). It has achieved substantial attention and focus in effort to attain the MDG goal on poverty alleviation (Balkenhol, 2007); addressing the failure of conventional banking system in helping the poor communities to escape spiralling and vicious circle of poverty (Chowdhury & Mukhopadhaya, 2012a; Conning, 1999) by extending credit access to the poor, i.e. 'the unbankable' (Simanowitz & Walter, 2002) who are deemed too risky thus excluded by formal banking institutions (Di Martino & Sarsour, 2012; Vanroose & D'Espallier, 2013). These poor also deemed unbankable since most have only desired small loans which commercial banks found unprofitable to serve (Armendariz de Aghion & Morduch, 2005).

Some are even barred from this access in spite of their creditworthiness, i.e. ability to provide collateral (Johnston & Morduch, 2008). Thus, Ahmed (2002) further argues that microfinance is a response to the failure of trickle-down development policy in eradicating poverty.

Fundamentally, microfinance institutions (MFIs) assist the poor by enabling access to credit to undertake income-producing activities (Armendáriz de Aghion & Morduch, 2000), which is considered as effective solution in poverty eradication (Li et al., 2011). The underlying assumption is that amongst the causes of poverty is lack of economic opportunities which can be bridged by microfinance (Comim, 2007). Thus, the focus of MFIs is the poor who are below and close to poverty line with skills or ideas to start entrepreneurial activities yet lacking financial access (Hartarska & Nadolnyak, 2008). It is considered as a capable method to assist distribution of income support and the creation of income-generating activities (Diop et al., 2007).

Indeed, microfinance has been applauded as making significant contribution in poverty alleviation, e.g. reducing number of poor from 60% in 1970 to 11.5% in 1996 in Indonesia (Seibel & Agung, 2006), spurring small business growth in various countries, e.g. Argentina, Philippine, Kenya and Senegal (Robinson, 2001), reconstructing households in war-torn countries like Bosnia-Herzegovina (Matul & Tsilikounas, 2004), and acting as recovery tool in disaster-torn areas, e.g. in Sri Lanka (Becchetti & Castriota, 2011). More than 3,652 MFIs reported to have served 205,314,502 borrowers worldwide as of 2010, of which 137,547,441 were considered to be from the poorest segment. This poorest borrowers can be translated into approximately 687,7 million family members if it can be assumed that a family consists of five family members (Maes & Reed, 2012).

I.1.2. Microfinance: Transaction Costs and Interest Rates

In their operation, the interest rates charged by MFIs are generally no less than that of mainstream banking institutions; which in most cases even much higher (Ahmed, 2002; Diop et al., 2007; Obaidullah, 2008a; Rahman, 1999). The justification for this is that MFIs deal with relatively small loan amounts which incurred the same if not higher transaction costs with large loans usually extended by mainstream banks. By targeting poor borrowers, these costs increase further due to three factors: small loan amounts, location of poor borrowers and group-lending method used to mitigate credit risks thus the fixed costs remain high (Diop et al., 2007), prompting MFIs to raise interest rates to cover these transaction costs (Chahine & Tannir, 2010; Conning & Morduch, 2011; Takahashi et al., 2010; Visconti & Muzigiti, 2009). Furthermore, borrower's rates of return is high in percentage terms thus paying for high interest rates is perceived as not harmful for the borrower (Ferro Luzzi & Weber, 2007; Obaidullah & Khan, 2008).

Nevertheless, this high interest rates combined with over-indebtedness and loan misuse had led to unfavourable excesses ranging from borrowers caught in spiralling debt (Hashemi et al., 2007; Li, 2010), which often forced poor borrowers to forego 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) due to aggressive loan procurement (Conning & Morduch, 2011; Servin et al., 2012). Armendariz de Aghion and Morduch (2005) further argue that poor borrowers would not be able to endure paying continuously high interest rates. This had been found to increase the odds of credit delinquency (Kodongo & Kendi, 2013) and eventually entrapping the poor borrowers into vicious circle of poverty (Obaidullah, 2008b).

I.1.3. Islamic Microfinance

Another obstacle hinders MFIs in gaining higher penetration in regions with substantial Muslim community who are faithfully observing religious or *Shari'a* law: the fact that interest-bearing loans contravene with the prohibition of interest or *riba* (The Louis Berger Group, 2010; UN-HABITAT, 2005). Whilst some poor Muslims who are strapped for cash yet lacking other options would accept interest-bearing loans, many others prefer to back away (Obaidullah, 2008a), creating unfulfilled demands for financing amongst the poor therein (Segrado, 2005). As an alternative, Islamic microfinance concept had thus been developed in the countries or regions with substantial Muslim community (Karim et al., 2008). It strives to provide better model to address the embedded issues of high interest rates and others in mainstream microfinance (hereinafter will be referred to as 'conventional microfinance') whilst complying with the interest prohibition in *Shari'a* law. In lieu of charging interest on loans, Islamic microfinance institutions (IMFIs) employ a range of *Shari'a* -compliant Islamic contracts to create an alternative interest-free financing mechanism to the poor. In its original conceptual mechanism, IMFIs extend in-kind, as opposed to monetary, assistance to the poor thus overcoming misuse and over-indebtedness (Ahmed, 2002; Obaidullah, 2008a).

Due to this notional characteristic, Islamic microfinance has become an important poverty alleviation tool in countries or regions with substantial Muslim population, complementing the drive from mainstream microfinance. However, it is currently still small in scale albeit growing parallel to that of wider Islamic finance industry. Despite the potential demand at the grassroots level, the growth of Islamic microfinance is still not as fast as that of Islamic banking nor as that of conventional microfinance. There are still limited number of MFIs that solely engaged in Islamic microfinance and also Islamic banks involved herein (Segrado, 2005). This fact was due to in part to the local regulation in some countries that limit or even hinder the growth of Islamic microfinance (UN-HABITAT, 2005), in addition to fewer donor/grant agencies that can support the growth of Islamic microfinance (Jones & Juul Petersen, 2011; Juul Petersen, 2012). With the exception of Indonesia, wherein the Islamic microfinance growth is driven by for-profit savings and loans cooperatives of Baitul Maal wat Tamwil (BMT), Islamic rural banks (BPRS), and later Islamic banks, the spread of Islamic microfinance globally was mostly driven by not-for-profit Non-Governmental Organisation (NGO), especially the development and relief NGOs; the biggest globally being Islamic Relief Worldwide and Muslim Aid.

I.1.4. Microfinance Performance and Double Bottom Line Objectives

The operational success of both MFIs and IMFIs are eventually judged by their actual performance against their *raison d'être* of poverty alleviation, i.e. how they can effectively assist their clients out of the cycle of poverty. In addition to this embedded social objective, MFIs are different from traditional financial institutions since they face objectives of outreach and financial sustainability (Yaron, 1994), i.e. double bottom line objectives (Marr, 2003) of aiding the poorest out of poverty whilst striving to sustain long term operation as viable financial institution. Microfinance therefore positions itself between poverty welfare schemes and traditional financial institution, presenting both outreach and financial sustainability as ultimate MFIs' objectives (Abdelkader et al., 2012; Hermes & Lensink, 2011; Vanroose & D'Espallier, 2013) and a standard by which MFIs performance will be evaluated (Yaron, 1994).

Nevertheless, reaching out to the poor has its own challenge. Transaction costs, i.e. all costs incurred to deliver MFI services to borrowers, are inevitably higher when poor borrowers are targeted, which is due to borrowers location, small loan amount, and loan delivery method chosen (Diop et al., 2007). Small loan amount incurred the same transaction costs with larger loans and poorest borrowers may be located in rural or hard-to-reach areas. Consequently, many field studies observed an inverse correlation between reaching deeper to the poorest and keeping a sustainable financial performance. A notion of trade-off between outreach and financial sustainability is thus suggested, e.g. in Hermes et al. (2011), Morduch (1999), Olivares-polanco (2005) and Schreiner (2002).

Due to this perceived trade-off, two different school of thoughts on how microfinance should focus its operation were later emerged, i.e. institutionalist approach which focuses on sustainability on one end of the continuum and welfarist approach which emphases on outreach on the other (Robinson, 2001). Alternatively, Simanowitz (2007) suggested the middle way that this trade-off can and should be managed. Similarly, Miyashita (2000) and Cull et al. (2007) also stresses on the importance of MFI strategy formulation and credit design to manage this trade-off.

I.1.5. Microfinance Performance

I.1.5.1. Microfinance Performance Defined

In evaluating MFI performance, there are two kinds of performance assessments; first, from the perspective of MFI beneficiaries in the form of an impact assessment, i.e. how MFI contributed to the improvement of its beneficiaries' standard of living, which is usually undertaken in the form of quantitative or qualitative field study. Secondly, performance assessment from the institutional perspective whereby an MFI is quantitatively evaluated in terms of its achievement toward its double bottom line objectives. Notwithstanding the complexity of the aforementioned dual objectives, comprehensive method is needed to be employed in microfinance performance measurement studies. As there are many MFIs operating in a given region or even other alternative policy options for poverty eradication, donor organisations and government regulators require an adept method that can appraise MFI accomplishment toward these dual objectives in order to decide whether to continue supporting its programme or to shift their support toward different MFIs. Moreover, microfinance provider itself requires a proficient method to evaluate its current achievement against that in previous periods and also against other MFIs working in the same area to continually improve their performance. Due to the presence of seemingly conflicting MFI objectives, this method needs to be comprehensive in analysing MFI performance in these two areas objectively.

Many quantitative microfinance performance studies had been undertaken using traditional financial ratio or indicators in their methodology, i.e. in various reports in MicroBanking Bulletin or various studies, among others in Churchill (1999), Khalily (2004) and Bhatt and Tang (2001). However, relying solely on traditional financial indicators, such as return on investments, profit margin and repayment rate is perceived as not sufficient to assess MFIs and IMFIs performance. The existence of social mission in microfinance means that sustainability therein does not necessarily have limited reference to profitability; rather, it is more of MFI’s ability to operate in long term without threat of bankruptcy (Nanayakkara, 2012). Thus, whilst there are some MFIs that achieve sustainability by reaching profitability (e.g. for-profit MFIs such as banks or rural banks), there exist some others, e.g. non-governmental organisation-based MFI (NGO-MFI or hereinafter will be referred to as NGO), where profitability is not a major focus thus achieving sustainability by contribution from donors or external grants; especially those of development NGOs providing microfinance services as ways to assist the impoverished communities in disaster and war-torn areas.

The use of traditional financial indicators to measure MFI or IMFI performance can also be ambiguous, i.e. an MFI could excel in one ratio but suffered in another thus it will be difficult to compare performance of different MFIs that excel in different ratios or indicators. An MFI focusing more on social outreach, such as development/relief NGO cannot be measured with the same yardstick with for-profit bank-MFI which has more focus on financial performance. Similarly, using outreach indicators, for example indicators presented in Rosenberg (2009), as sole benchmark for MFI performance would pose the same problem for more commercially-focused MFIs. These two objectives cannot be interpreted separately as many MFIs combine them differently in their strategy. Taking in isolation, these measurement indicators will face MFI stakeholders, e.g. donors/grant institutions, regulators and even the MFI management themselves with confusion when they want to objectively compare the overall performance of an MFI against other MFIs or when they want to find the best performing MFI among several MFIs operating in the same region (Balkenhol, 2007) as it only provides a partial evaluations of performance (Bogetoft & Otto, 2011).

However, aggregation problem occurs when all these indicators are combined into one assessment criterion (Fluckiger & Vassiliev, 2007). In any organisations or business operations, basing performance to single indicator would overlook any substitutions, interactions and trade-offs between several performance measures (Bogetoft & Otto, 2011; Zhu, 2003). This is even more apparent for the case of microfinance institutions characterised by their dual objectives. On the other hand, benchmarking with competitors in industry is essential in driving MFIs to improve their performance toward achieving their objectives; thus an alternative method that embraces social and financial objectives of MFIs is needed herein. Furthermore, this performance criterion should be flexible enough to also evaluate all priority combinations of social and financial performance objectives of MFIs, i.e. it should be able to be used to observe which MFI is best in term of either social or financial objectives should the need to analyse one objective in isolation is also needed.

I.1.5.2. Microfinance and Efficiency

One such adept criterion to incorporate MFI's social and financial missions is efficiency. Efficiency is a notion relating the use of input to create output, with working definition being the optimal utilization of available inputs in transformation process to produce outputs (Thanassoulis, 2001). Balkenhol (2007) accordingly proposed the use of efficiency as MFI performance measurement criterion as it is able to comprehensively measures both financial and social goals of microfinance thus "equally applicable to commercially viable MFIs and not yet financially self-sustaining MFIs that seek more immediate poverty reduction" (ibid:9).

In its basic form, it is traditionally calculated as output production over input, e.g. cost per unit, production per labour hour (Cooper et al., 2000). In other words, the basic translation of efficiency was a series of several efficiency indicators or ratios, comparable to that of financial indicators. In this interpretation, efficiency is not a new concept in microfinance context whereby the application herein had been developed from one measure of operational efficiency ratio in MicroBanking Bulletin in 1997 into five indicators in MicroBanking Bulletin 2006 (Balkenhol, 2007); akin to Key Performance Indicators (KPIs) generally used in business. However, this approach of efficiency poses the same problem with using separate financial or social ratios as mentioned earlier as this "do not capture how the multiple inputs affect simultaneously the multiple outputs of the transformation process carried out by the unit being assessed" (Thanassoulis, 2001, p. 6). These separate ratios would not make comparison or benchmarking easier as discussed earlier, as MFIs may excel in one ratio but fall behind in others. More importantly, it will not be able to really incorporate microfinance's financial and social goals for benchmarking purpose.

As transformation process in microfinance involves complex interaction of multiple inputs into multiple outputs with seemingly conflicting financial and social objectives, the efficiency approach in microfinance demands a more systematic approach that embraces this complexity. There is a problem of benchmarking as well in this regard; efficiency concept is arguably a relative concept, i.e. how efficient is one firm (in this case, an MFI) utilises its available inputs in transformation process into outputs in comparison to a benchmark performance. Nevertheless, a proper benchmark needs to be defined. Efficiency ratios as suggested in MicroBanking Bulletin are generally measured against average industry performance as benchmark, which merely indicates a benchmarking to the average or mediocre MFI performance. More importantly, it is principally means that it is a benchmarking against a hypothetical performance which cannot be emulated to improve one's performance.

Thus, microfinance needs modern benchmarking approach; a 'frontier approach' as per Charnes et al. (1978), i.e. a modern benchmarking that employs frontier analysis methods in which relative efficiency is compared to benchmark(s) in a frontier created from best practice in industry with similar characteristics/attributes. This method enables MFI to emulate the best practice from its benchmark(s) with similar characteristics to improve future performance. One such method is Data Envelopment Analysis (DEA); a non-parametric efficiency analysis based on linear programming method that has been used in wide range of industry. Although still not widely used in microfinance, it has been used several studies, among others in Gutiérrez-Nieto et al. (2009), Gutiérrez-Nieto et al. (2007), Islam et al. (2011), Hassan and Sanchez (2009), Nghiem et al. (2006), and Bassem (2008). As DEA enables different inputs-outputs specifications to measure different types of efficiency, MFI's outreach and sustainability can be regarded as social efficiency and financial efficiency (Gutiérrez-Nieto et al., 2009), with overall efficiency encompassing these two goals; specifications of which valuable for benchmarking purpose.

I.1.5.3. Issues in Microfinance Efficiency Measurement

There are indeed some important issues that should be highlighted in microfinance efficiency measurement, as described in the following:

a) Conventional versus Islamic microfinance

As will be reviewed more in detail later, Islamic microfinance uses different schemes in its offerings than conventional microfinance. It is originally intended to provide alternative financing schemes to avoid interest-bearing loans with its all its consequences in microfinance context, e.g. high interest rates charged to poor borrowers and poor borrowers effectively subsidising less poor borrowers from their savings (Diop et al., 2007). This intention thus needs to be substantiated, i.e. whether empirical efficiency studies find that Islamic microfinance can perform better or at least equally with its conventional counterparts.

Interestingly, most if not all comprehensive studies on the performance of microfinance institutions in terms of their outreach and sustainability and their efficiency had only been performed on conventional MFIs. Though IMFIs have started to play instrumental part in Muslim-majority regions in Asia, Africa, Central Europe and Middle East and North Africa (Karim et al., 2008; Obaidullah & Khan, 2008; Parveen, 2009), there have been no comprehensive empirical study that have assessed their outreach and sustainability let alone efficiency. These limited empirical study that had been performed were mostly employing financial indicators to assess IMFIs (partial) performance. Accordingly, benchmarking studies that are available are only those comparing IMFIs performance with average or hypothetical performance (in the form of average performance ratios). Therefore, given its potential and its operation thus far, comprehensive empirical study is imperative to evaluate how IMFI perform vis-à-vis its double bottom objectives.

The limited number of study in IMFI performance was arguably due to the smaller current numbers and coverage of IMFIs in comparison to that of MFIs globally, yet, the trend has shown sharp increase (Karim et al., 2008). Another reason is that secondary data on IMFIs are still very difficult to be obtained from data clearinghouse such as Microfinance Information Exchange (MIX Market). Nevertheless, this empirical gap between IMFIs and MFIs is crucial to be observed further as IMFIs will continue to have increasing role in poverty alleviation policy in developing countries with substantial number of Muslim population who would only choose to seek financial assistance without compromising their faith. Given the number of Muslim population under poverty line in developing countries, the roles of IMFIs should not be ignored in achieving MDG. Likewise, it is also beneficial to observe the extent to which IMFI offering alternative financing scheme perform in comparison to that of MFI. This information is essential to microfinance stakeholders such as government/regulators and donor institutions to gain their support.

b) Panel data availability and quality

Microfinance sector is still regrettably not as established as that of mainstream financial institutions such as insurance, commercial banking sectors and capital markets. Many MFIs, specifically not-for-profit MFIs, are also not yet required to be regulated in many of the countries they are operating. Consequently, they are not required to submit periodical financial report to central banks in their operating countries. This creates a challenge to researcher in this area, i.e. the availability of high quality balanced panel data, especially from smaller MFIs and from new microfinance-adopting countries; with IMFIs data is even poorer than that of MFIs. The dataset that are currently available in centralised global databases are sourced from data that are voluntarily submitted by global MFIs to global data clearinghouses e.g. Microfinance Information Exchange (MIX Market), Consultative Group to Assist the Poor (CGAP), Microfinanza Rating and PlaNet Rating Agency. Unfortunately, not all of these data are of high quality, albeit later on adjusted and audited by these clearinghouses (Annim, 2010; Balkenhol, 2007), and the panel data available are mostly unbalanced. Indeed, not all MFIs globally at the moment submit their data to these clearinghouses and the number of reported MFIs are still far below all MFIs operating globally (Balkenhol, 2007).

This condition unfortunately is the limitation of the current state of microfinance sector, which is the opposite of the availability of mainstream banking sector data from global database such as Bankscope, Reuters and Bloomberg. Amongst all these clearinghouses, however, MIX Market is considered to be the best database provider for microfinance sector at the moment, whose dataset covers the widest regions globally and includes most, if not all, large and long-running MFIs operating globally. MIX Market dataset have been used in nearly all microfinance studies employing secondary data in country, regional, and global scopes.

Indeed, studies related to relationship between MFI regulation and efficiency shows mixed results, for example Lafourcade et al. (2005) who observed that regulated MFIs as having higher social efficiency whereas Hartarska and Nadolnyak (2007) could not find any significant relationship thereof. Nevertheless, should MFIs are required to be regulated akin to commercial banks (hence regularly submitting financial report to central banks), more high quality data will be available from global MFIs that will contribute to MFI transparency that are beneficial for all microfinance stakeholders. Many countries have now started the drive to regulate MFIs as financial institutions that are monitored by central banks thus it is expected that the global dataset will gradually improve in the future. This is indeed a proviso to the reliability to microfinance research employing cross-country secondary data. At the moment, due to this challenge, a comprehensive efficiency measurement method that can deal with this condition is inevitably needed.

c) Microfinance productivity analysis

Even though frontier efficiency methodology such as DEA has been applied in several MFI efficiency studies, there are still limited studies on MFI productivity growth based on this methodology. The term productivity herein referred to total factor productivity, i.e. productivity measure concerning all factors of production, as opposed to traditional productivity ratios such as machine productivity per hour, i.e. partial productivity measures (Coelli et al., 2005). Measurement of productivity growth over time is an assessment of total factor productivity growth over time; it is an important part in performance measurement as growth cannot be directly calculated from the change in efficiency scores from one period to another as they may face a different production frontier, i.e. different technology in industry. Measurement of productivity growth over time therefore assesses progress (or lack thereof) in efficiency as well as in progress (or lack thereof) in frontier technology over time under the multiple inputs and multiple outputs environment (Tone, 2004).

Frontier-based productivity growth measurement had been applied greatly in traditional banking sector as summarised in Fethi and Pasiouras (2010). In the microfinance context, however, it had only been utilised in small number of studies, e.g. Hassan and Sanchez (2009) and Bassem (2014) wherein standard Malmquist Index for panel data are used. Limited DEA-based total productivity growth analysis in microfinance sector may be related to the limited availability of balanced panel data mentioned previously. Therefore, a suitable model should be devised to circumvent this condition.

Moreover, microfinance have long been regarded to have immunity against external shocks such as financial crisis and other macroeconomic shocks due to its unique business model and niche target market of the 'unbankables' (Di Bella, 2011; Gonzalez, 2011; Wagner & Winkler, 2013). This reputation had especially flourished due to microfinance sector's ability to survive the 1997 East Asian currency crisis and 1999-2000 Latin American crisis unscathed (Chen et al., 2010). In fact, this perception had become a magnet for microfinance sector; many traditional/mainstream financial institutions and investors have now regarded microfinance as separate asset class providing attractive investment with different risk specification yet with attractive return and social purpose. Many have poured investment into microfinance and have been used by MFIs to embark upon credit-led expansion. Thus, it raises a thought-provoking question: with the increased participation of traditional financial institutions and investors in MFIs in terms of commercial borrowings, whether the sector still has immunity against global crisis and other external shocks as it has before. This is a crucial question, especially after the 2008 global crisis which had more disastrous and lasting impacts globally than the 1997 East Asian currency crisis and 1999-2000 repayment crisis. Moreover, this question needs comprehensive empirical analysis in global scope.

I.2. Research Gap and Research Questions

I.2.1. Research Gap

An empirical gap is thus observed in the knowledge between the performance comparison of MFIs and IMFIs vis-à-vis their dual objectives, more specifically in terms of their social and financial efficiency, in both not-for-profit and for-profit orientation. Existing studies in regard to comparison between Islamic with conventional have made no distinction between MFIs with different profit orientation; on the contrary, studies of not-for-profit MFIs versus for-profit MFIs also have not made any distinction between Islamic and conventional method adopted in the MFIs observed. Empirical gap is also observed in terms of efficiency and productivity growth measurement for microfinance institutions that can circumvent the balance data unavailability and different efficiency orientation strategy, especially regional-based empirical evidences for six main regions for microfinance, i.e. Africa, East Asia and the Pacific (EAP), Eastern Europe and Central Asia (EECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), and South Asia. In addition to this, gaps in knowledge are also observed in terms of the relationship between loan offering methodology used by MFIs with their efficiency and environmental factors influencing their efficiency.

I.2.2. Research Questions

Therefore, research questions that would be analysed are as follow:

1. First and foremost, are there any significant differences in IMFIs' efficiency in comparison to that of MFIs in regard to social efficiency and financial efficiency?

2. What is the relationship of loan offering methodology chosen by not-for-profit MFIs to their efficiency in different region?

3. How do environmental factors, e.g. borrowings, donations, interest rates, legal format, MFI age, to its efficiency in different region?

4. What is the productivity growth of not-for-profit microfinance institutions in different regions thus far?

5. Since the world have just recovered from 2008 global financial crisis, to what extent have not-for-profit microfinance productivity been affected by this crisis, in comparison to for-profit microfinance?

I.3. Research Methodology

This research strives to answer the above questions in three interconnected quantitative studies based on non-parametric frontier efficiency method of DEA.

The first research question acts as the litmus test for further analysis, i.e. whether the difference in performance between IMFIs and MFIs is significant to warrant separate side-by-side further analysis. It will be observed in a study that employs basic model of DEA; more specifically, output-orientation and input-orientation Bankers, Charnes, and Cooper (1984) model or BCC-DEA model. DEA methodology is argued as an adept method in measuring MFI efficiency as it constructed production frontier from best-performing MFIs to which individual MFI performance is assessed. This enables individual MFIs to benchmark its performance against the best actual performance of MFI with the same characteristics, rather than basing their performance to a hypothetical average performance. Analysis herein observes IMFIs and MFIs efficiency comparison in relation to overall, social and financial efficiency measures.

The study is undertaken in three regions, i.e. EAP, MENA and South Asia, covering 231 microfinance institutions for the period of 2009 – 2010 with both global- and regional-based assessments. This first study proposes the use of social-financial efficiency matrix to map out MFI position toward its dual objectives and overall efficiency to observe the overall MFI performance, albeit the latter is proposed to be used in conjunction with MFI social and financial efficiency to understand MFI tendency toward on its objectives. The study uses data available from MIX Market; furthermore, qualitative primary study from interview and field-observation in Indonesia is used to explain and to complement the DEA results.

The second and third questions above are assessed in the second study in this research that observes the relationship of loan method to efficiency. In this study, the assumption of the DEA model is relaxed; instead of imposing a forced uniformity amongst MFIs in analysis into using same strategy (either input- and output-orientated), a non-oriented DEA model is utilised whereby MFIs in analysis can implement different strategy that is more suitable for their condition. This model is used as it resembles more to reality; an MFI may not be able to maximise outputs or minimise inputs due to constraints. Where an MFI cannot undertake output-maximising strategy solely, it will not be realistic to evaluate it using output-orientated DEA model, and vice versa. The relationship of loan method, the loan ranking and the influence of environmental factors to MFIs efficiency is observed herein using Tobit regression in the second-stage analysis.

The study covers 628 not-for-profit MFIs from 87 countries in 6 regions above, i.e. Africa, EAP, EECA, LAC, MENA, and South Asia. Not-for-profit NGOs has been regarded highly as microfinance provider due to its uncommercial nature (Morduch, 1999), leading the way in poverty alleviation effort by bringing in international grant and experience (Nghiem et al., 2006) and empirically found to serve the poorest and to have negative relationship to 'mission drift' (Serrano-Cinca & Gutiérrez-Nieto, 2014). Mission drift is a condition whereby an MFI starts to seek more profitability by focusing on less poor clients whilst crowding out the poorest at the same time (Armendariz & Szafarz, 2011). This study thus extends not-for-profit classification to MFIs other than NGOs, such as cooperatives and other format. In order to circumvent the problem of panel data availability, this study uses meta-frontier approach to envelope all MFIs data from all period available into one frontier so that they can be compared directly.

Finally, in dealing with the fourth and fifth questions in the third study a Circular Malmquist Index is modified to measure the total factor productivity growth of not-for-profit MFIs in six regions under non-oriented environment, in relation to 2008 global financial crisis. Currently limited published DEA-MFI studies mainly calculating total productivity growth using standard Malmquist Index that is applicable where a balanced data is available. In the case of MFIs, regrettably balanced data is not always available. Therefore, modification should be applied herein. The third study will make comparison with productivity growth from for-profit MFIs as well. The third study will analyse data from 1779 DMUs in 110 countries globally for the period of 2003-2013, covering 10,221 DMUs in total.

I.4. Aims of the Research

The aim in this research is to propose empirical evidence to the efficiency, productivity growth, and resiliency against crisis for not-for-profit microfinance institutions in different regions under the condition of lacking balanced data. In so doing, this research aims to contribute to the DEA, microfinance, not-for-profit and productivity literatures, especially in the use of meta-frontier approach and non-orientation assumption.

The objectives of this research are thus multiple:-

- To assess the comprehensive performance comparison of MFIs and IMFIs in its overall, social and financial efficiency relative to regional frontier and global frontier;
- To propose the social-financial efficiency matrix to monitor MFI performance in relation to its dual objectives of outreach and financial sustainability, with ultimate

intention to manage this dual objectives to be achieved simultaneously in the light of apparent trade-off thereof;

- To propose DEA specifications to analyse overall efficiency, social efficiency and financial efficiency of microfinance scheme, applicable for both not-for-profit and for-profit microfinance institutions, with focus on not-for-profit microfinance institutions;
- To observe the notion of 'best' loan method for not-for-profit MFIs in each regions under analysis, i.e. the loan offering methodology that empirically assist not-for-profit MFIs in reaching higher social and financial efficiency;
- To propose non-oriented DEA model as an adept and more realistic methodology to assess MFIs' efficiency where MFI is not forced to assume one uniform strategy of either input- or output-maximising in efficiency measurement; rather, different MFIs can be assessed with different strategies befitting to them in the same analysis;
- To analyse relationship of environmental factors that may influence MFIs' efficiency in each regional frontier observed, e.g. operational age, borrowings, interest rates, donations, portfolio at risk, MFI regulation, MFI legal format;
- To present modified model to assess MFI productivity growth over time in the condition where balanced data is not available and under non-oriented analysis;
- To evaluate the not-for-profit MFIs productivity in the face of external shock, especially the 2008 global financial crisis, in comparison with for-profit MFIs to take valuable lessons to build stronger resistance in the future;
- To present policy recommendation to MFIs and MFI stakeholders in each regional observed.

I.5. Research Contribution

The contributions sought in this research are of multiple aspects. It seeks to fill the empirical gap of performance comparison between Islamic and conventional microfinance and between not-for-profit and for-profit MFIs plus factors taking place in the field that may make microfinance's good theoretical objectives cannot be translated well into action. It upholds DEA as adept and proper analysis method in assessing microfinance performance; moreover, it proposes the application of meta-frontier approach and non-orientation assumption to present a more realistic model for performance assessment due to absence of forced uniformity in microfinance strategy under analysis. In this effort, it proposes the use of an effective social-financial efficiency matrix to monitor MFI positioning in terms of its dual objectives.

Secondly, this research aims to propose the use of non-oriented Circular Malmquist Index to assess productivity growth over time in microfinance context, which is applicable to MFIs situation of lacking balanced data. As productivity growth over time is a very important part of efficiency measurement yet still lacking in DEA-microfinance and the general microfinance literatures.

Thirdly, this research seeks to contribute to DEA literatures, especially in regard to the application of non-oriented hyperbolic DEA and productivity growth in microfinance performance measurement. It also aims to make contribution to microfinance and not-for-profit literatures, i.e. in regard to the alternative method to performance measurement.

Fourthly, this research seeks to contribute to MFI productivity studies, especially in regard to not-for-profit microfinance institutions in times of crisis.

Fifthly, this research aims to support global poverty alleviation effort by proposing comprehensive efficiency and productivity growth measurement method and policy recommendation to MFIs and MFI stakeholders, especially in the case of not-for-profit microfinance institutions.

Finally, this thesis strives to enhance Aston Business School's and Aston University's position globally as distinguished and exemplary research university by contributing knowledge to global poverty alleviation programme thus opening further research engagement and opportunity with not-for-profit microfinance institutions.

I.6. Structure of the Thesis

This thesis will be structured in the following manner: chapter 1 describes the research background, brief introduction to concept covered in the thesis, then followed by the research gaps, questions, methodology and contributions. Thereafter, chapter II until IV describes the conceptual framework part of the thesis. The background concept of poverty and microfinance, including the theoretical differences between conventional and Islamic microfinance, are introduced in depth in chapter II. Chapter III follows by summarising the concept of efficiency and productivity concept, whilst chapter IV presents the concept of DEA, circular Malmquist index; especially in the context of microfinance. Chapter V presents the first study of efficiency comparison between Islamic and conventional microfinance institutions in EAP, MENA, and South Asia regions, both in global frontier (global scope) or separately in these three regional frontiers. The second study on the relationship between loan methodologies with efficiency of not-for-profit MFIs is then laid out in chapter VI, along with the relationship of several environmental factors to efficiency. Subsequently, the final study observing productivity growth of not-for-profit MFIs is presented in chapter VII, followed afterward by final analysis, conclusion, and recommendation in chapter VIII.

Chapter II: Poverty and Microfinance

II.1. Introduction

This chapter presents the basic conceptual understanding about this research. It firstly starts in Section II.2 by presenting the theory about poverty and types of poverty. Section II.3 subsequently followed to introduce the concept of microfinance as one of the solutions in poverty alleviation. The dual bottom objectives of microfinance are introduced herein, along with the different loan methodologies, theoretical advantages and critiques of current microfinance application. Section II.4 further introduces the concept of Islamic microfinance, which has been heralded as Islamic faith-based alternative to mainstream “conventional” microfinance to cater for the needs of those customer segments that have faith-based reservation to deal with interest-bearing loans. This section explores the conceptual differences between Islamic and conventional microfinance, the transactional schemes that are widely used in Islamic microfinance, its theoretical advantages over the conventional microfinance, and also critiques to the current practice of Islamic microfinance. Section II.5 thus closes this chapter with summary of its content.

II.2. Poverty

II.2.1. Poverty Defined

As microfinance is prescribed as one of the solutions in poverty alleviation, it is therefore important to look first at how poverty is defined and conceptualised so that the impact of reducing poverty through microfinance can be thoroughly understood.

The concept of poverty has evolved along the years. It is defined in relation to household income, i.e. as to be a condition wherein households lacking sufficient income and other resources to fulfil their basic needs to take part of, to contribute to and to participate in their society (Townsend, 2006). Poverty is correspondingly defined in

Encyclopaedia Britannica as the condition of "one who lacks usual or socially acceptable money or material possessions" and "when one lacks means to satisfy basic needs" ("Poverty," 2015). This is due to restricted access to basic needs, which in turn can be attributed to, among others, constraints of government services, i.e. corruption, loan conditionality and debt. This is also termed as the monetary approach to poverty that still gains currency today; identifying poverty to income and consumption below a stated poverty line (Laderchi et al., 2006).

This concept of 'basic needs' expands the understanding of poverty from early definition of a condition deprived of subsistence for physiological needs stemmed from nutritionists in Victorian era (Townsend, 2006), to cover two aspects of minimum conditions of private household and important basic needs in society, e.g. sanitation, drinking water, education, and healthcare. This concept of 'basic needs' therefore covers two aspects of minimum conditions of private household and important provisions in society, e.g. sanitation, drinking water, education, and healthcare. It thus opens the acknowledgement of a multi-dimensional nature of poverty that is widely accepted today, i.e. not limited to merely deprivation of ability to survive at subsistence level (Diop et al., 2007).

Poverty can also be viewed from the perspective of absolute poverty and relative poverty. Absolute poverty is defined as a condition where one lacks access to basic human needs, i.e. nutrition, health care, clean and fresh water, clothing, shelter and education. Relative poverty on the other hand is that where one lacks a usual and socially acceptable level of resources or income in comparison to others within a similar society, region or country, which spurs the discussion of inequality (Diop et al., 2007).

Hulme and Shepherd (2003) and Diop et al. (2007) furthermore suggest that since the poorest segment is more likely to be exposed to shock and volatility in household income and also to suffer the inability to extend income to cover basic needs over periods of time since they have a fewer means in managing in difficult times, thus vulnerability is recognised as the ultimate aspect of poverty. For that reason, policies and assistance to help the poorest have been aimed to reduce vulnerability, one of which is microfinance (Morduch & Haley, 2002; Zaman, 2000).

II.2.2. Measurement and Taxonomy of Poverty

One of the widely used methods to assess and to compare poverty level in a global level is the use of the poverty line method. Poverty line in a given country is a widely accepted reference in assessing the extent of poverty in that particular country. Whilst poverty lines vary across countries due the difference in their purchasing power, the World Bank's standard of 'USD1 a day' measure has been widely used as proxy to compare the extent of poverty in different countries (S. Chen & Ravallion, 2010). This method compares household or individual income and spending to a monetary threshold calculated by the local currency equivalent of certain USD dollar per day, based on 1985 US dollar prices, which represents costs of basket of basic goods and services needed (Diop et al., 2007). It therefore measures the depth and intensity of poverty, i.e. by observing how far a household income is from the poverty line, and also potential poverty, i.e. by comparing household actual income and the amount it can potentially achieve.

One criticism on poverty line method is its global representation. A poverty line of USD1-a-day is suitable to represent of domestic poverty in low-income countries, i.e. countries located in South Asia and sub-Saharan Africa. Nevertheless, this definition is not as representative to be used in middle-income countries, let alone developing countries; it is thus more depicting a conservative line for middle income countries (Besley & Burgess, 2003). As for developed countries, different standard needs to be applied as the above poverty line would leave no one in poverty condition. Another criticism for poverty line method is that classifying the poor according to this method without further analysis may bring out an inconsistency between the widely-accepted recognition of multi-dimensionality of poverty, i.e. the theory, with the application herein which seems to recognise monetary income as sole indicator of poverty.

Sen (1981) had warned that classification of those under poverty line as one homogeneous group without deeper analysis may render the analysis to be weak and the poverty alleviation policy to be ineffective. Accordingly, Hulme and Shepherd (2003) argue that the recognition of different features of poverty is very important, as there is a condition of *chronic* poverty, i.e. a condition of structural poverty that is suffered persistently for much of the life course of the poor and may subsequently be passed on to the next generation, and there is also *transient* poverty, whereby poverty is endured as temporary condition due to external shocks (such as wars, natural disasters, and humanitarian crises) thus the poor has higher likelihood to convalesce if situation improves or opportunity arises. Therefore, they further argue the importance of recognising five levels of poverty condition in relation to poverty line measures in order to design and to deliver an effective poverty alleviation policy, such as the following:

1. **Always poor**

   This includes those whose mean poverty scores of basic needs and other indicators (such as household income, consumption, nutritional status, human development index, etc.) in each period are persistently below the poverty line, i.e. the poorest segment.

2. **Usually poor**

   This encompasses those whose overall poverty scores in all periods observed are below the poverty line, yet are not suffered from poverty in every period.

3. **Churning poor**

   The segment whose mean overall poverty scores are around the poverty line and endure poverty in not all but some periods from observed periods.

4. **Occasionally poor**

   This class consists of those whose mean overall scores are above the poverty line but have experience falling below the line in one or more period(s) under observation.

5. **Non poor**

   This groups those whose mean indicator scores to be always above the poverty line.

Consequently, the condition of chronic poor consists of those in the always poor and usually poor levels, whilst the condition of transient poverty encompasses those in the churning poor and occasionally poor. In setting strategy for the poverty alleviation programmes, such as microfinance, these different levels of poverty condition of the policy target have to be considered to ensure more accurate targeting. Those that are regarded as located in level of usually poor and churning poor (and sometimes the occasionally poor) are commonly referred to in various microfinance literatures as less poor, 'working' poor or 'entrepreneurial' poor, among others in Comim (2007), Mosley and Rock (2004), and D'Espallier et al. (2013). Correspondingly, Navajas et al., (2000) refer to the churning poor as 'the richest of the poor' and to the occasionally poor as 'the poorest of the rich'. This different classification of the poor target thus sometimes complicates the impact evaluation of microfinance in terms of outreach to the poor.

II.3. Microfinance

II.3.1. Concept of Microfinance

Based on the approach stated in the previous section, poverty stemmed from insufficient household income that causes a household to fall below the poverty line; thus unable to fulfil its basic needs. This condition is worsened when the poor is barred from credit access due to loan conditionality from traditional banking institutions (Vanroose & D'Espallier, 2013) that would otherwise beneficial to start an income-generating activities. Commercial banking and financial system reluctance to finance the poor, the marginalized and the poorest of the poor are due to the high cost of financing, processing and perceived lack of collaterals requirement (Obaidullah, 2008a). It thus further denies the poor from access to improve their living standards and opportunity to move above poverty lines.

Consequently, one of the solutions to improve the condition of people facing this condition is to develop an income support to the poor directly or to devise a mechanism that enables the poor to start an income-generating activity. The second solution is regarded as more appropriate in the long run as it warrants sustainable improvement due to the idea of helping people to help themselves (Copestake et al., 2005; Moodie, 2013). The underlying assumption herein is that poverty is attributable to lack of economic opportunity (Comim, 2007) and that the poor also has potential entrepreneurial skills yet could not be put to work due to lack of opportunity (Hulme, 2000; Worthen, 2012); thus, enabling financial access to the poor will equip them to embark upon income-producing activities to escape the spiralling poverty.

Microfinance is thus prescribed as a solution to this problem. Microfinance is essentially a provision of loans and savings to the poor (Schreiner, 2002), i.e. the 'unbankables' who are barred from financial access to mainstream banking institutions. Microcredit Summit defines microfinance in more detail as a delivery of small loans and other financial and non-financial services, e.g. business training, health services, and deposits, to the very poor; It assists them to improve living standard for their families by engaging in income-generating self-employment activities (Microcredit Summit, n.d.). Robinson (1998, pp. 390–391) refers to microfinance as "small-scale financial services for both credit/financing and deposit, provided to people who farm, or fish or herd; that operates micro- or small enterprises where goods are produced, recycled, repaired or traded; provided service; working for wages or commissions; renting land or vehicles or tools; and to other individuals and local groups in developing countries, in both rural and urban areas". These working definitions of microfinance stating one thing: assisting the poor to break out of poverty circle is primary mission or *raison d'être* of microfinance. In relation to basic assumption behind the cause of poverty, microfinance thus opens up financial access with accessible eligibility criteria to the poor to kickstart micro-entrepreneurial activities.

Microfinance was pioneered by Grameen Bank in Bangladesh in 1976 and has rapidly gaining popularity over the past three decades as a promising solution to global poverty problem (Gomez & Santor, 2001; Khandker, 2001). Due to this influential work, Grameen Bank founder Professor Muhammad Yunus has been awarded Noble Peace Prize in 2006. From Bangladesh and Bolivia, microfinance has now spread globally to other parts of Asia, Africa, all over Latin America, the Caribbean, Eastern Europe, and Central Europe.

Microfinance has different features in its service to the poor in comparison to mainstream financial institutions such as the following:

1. Group-Based Lending

Grameen Bank started in 1976 by lending small working capital loans to poor borrowers, with focus on women borrowers. Loan was extended without requiring any collateral, thus revolutionizing banking practice, by using a group-based lending (hereinafter will be referred to as 'group lending') where borrowers voluntarily form a small group of borrowers. This group provides mutual and morally binding guarantees in lieu of collateral (Dusuki, 2008b; Khandker et al., 1994). More thorough analysis on group lending will be presented in later section.

Group lending aims to create not only loan repayment incentives, but also to build social capital and to achieve wider social objectives (Gomez & Santor, 2001; Rankin, 2002). These groups were utilized in an organizational structure arranged to educate members about various social and family matters, e.g. public health, childcare, family planning and business opportunities.

2. Women Empowerment

In their lending activities, Grameen Bank and other MFIs focus on women borrower as target borrower. In Grameen Bank, 97% of its 7.9 million borrowers are women (Hamada, 2010). The underlying assumption is that women have closer ties to the family in their household compared to men; They are expected to uphold family's prosperity above theirs and to use the loans productive activities as intended (Ahmed, 2002). Empirical evidences show that women are reliable borrowers and also tough entrepreneurs that, from microfinance, have been able to raise their status, lessen their dependency on their husbands and improve their children's nutritional and educational standards (Cheston & Kuhn, 2001; Khandker et al., 1994; Rankin, 2002). Pitt and Khandker (1998) found that credit given to women borrowers is more likely to affect household expenditure, non-land assets held by women, male and female labour supply and boys and girls schooling than that given to men, with increase in annual household expenditure from credit given to women is 1.63 times higher than that to men.

3. Source of Funds

Significant source of funds for MFIs are mainly from government, the central bank, and both multinational and national donors, such as USAID, DFID, Bill Gates Foundation, and IFC, especially those microfinance runs by NGOs (Helms, 2006; Maisch et al., 2006). Nevertheless, this dependency is often viewed to be so excessive that some argue that

MFIs run by NGOs would not reach break-even point without relying on external subsidies, among others in Parveen (2009). Khandker et al. (1994) even observed as early as in 1994 that Grameen Bank would operate in a loss had it not been for foreign donors. This raised the issue of operation or financial sustainability for MFIs which will be covered in Section II.3.2 below.

Funding issue had nevertheless encourages some MFIs to be innovative. As an example to this, Grameen Bank in 2008 have explored unconventional source of funds by tapping into Bangladesh capital market, launching closed-end mutual fund to provide alternative source of funding (Yunus et al., 2010).

II.3.2. Double Bottom Objectives, Trade-off, and Different Approaches

As briefly introduced in Section I.1.4, microfinance as poverty alleviation instrument has a unique double bottom objectives of outreach and financial sustainability. This section will discuss these objectives more thoroughly, the trade-off between these objectives along with different approaches stemmed from it.

II.3.2.1. Outreach

The working definition of outreach that will be used throughout this thesis is the extent to which microfinance institutions can offer assistance to the poor, i.e. how far MFIs can reach the poorest of the poor. Schreiner (2002, p. 592) refers to outreach as the "social benefit of microfinance to the poor". The arguments are that MFI that penetrates to the poorest of the poor in the deeper level of outreach depth would help to alleviate poverty at its deepest core possible where aid is dreadfully needed. Thus, the more poor people that MFI can reach, the stronger its poverty elimination power (Nanayakkara & Iselin, 2012). Furthermore, Navajas et al. (2000) and Schreiner (2002) offer six different aspects in understanding microfinance outreach, which can be summarised in the following:

1. **Breadth of Outreach**

   Breadth of outreach measures how many borrowers that can be served by MFIs, signifies the spread of MFIs and IMFIs assistance to wider audience of the poor.

Provided that the target borrowers are poor borrowers, the larger number of borrowers reached means the larger impact of MFIs or IMFIs toward poverty alleviation.

2. **Length of Outreach**

   This aspect is about the time duration needed by MFIs to process loan application, which is an essential parameter since longer duration may mean that MFI will not have the ability to improve welfare quickly enough in the long term.

3. **Scope of Outreach**

   This aspect measures the number of financial contracts offered by MFIs to their borrowers; the more products offered the wider the outreach.

4. **Depth of Outreach**

   This is the ultimate aspect of microfinance that is often has exclusive connotation with the term 'outreach'. It signifies how deep the MFIs and IMFIs could have impact to the poor community, i.e. whether it can reach the poorest of the poor. The widely used proxy for this aspect is average loan balance per borrowers thus the smaller the loan balance the deeper its outreach; the more MFIs or IMFIs can penetrate to the poorest community. The underlying assumption is that the poorest of the poor demand smaller loan values to start self-employment project.

5. **Worth to Users**

   This denotes how much a borrower is willing to pay for a loan from MFIs, which is very difficult to measure due to borrowers' subjectivity.

6. **Cost of Users**

   This denotes the cost of a loan from MFIs and IMFIs to a borrower, which includes both price costs and transaction costs. Price cost is measured by internal rate of return as a proxy for interest rates, whilst transaction costs include non-cash opportunity costs and indirect cash expenses (e.g. transport, document, taxes).

Given different aspects of outreach above, studies on microfinance outreach can yield different results since they can focus on different aspects of outreach. Thus, the definition of outreach needs to be specified beforehand. Conclusion on microfinance outreach depends on measurement and specification of outreach applied in that particular study. In this thesis, outreach of microfinance will be focused on the depth of outreach and breadth of outreach since it is argued herein that these aspects are best to measure how microfinance reaches out to the poor, especially depth of outreach in observing the extent to which microfinance can penetrate to the poorest of the poor who are in chronic poverty.

II.3.2.2. Sustainability

On the other hand, sustainability is defined as permanence, i.e. the ability of microfinance institution to sustain its microcredit operations and other activities as a viable financial institution (among others in Cull et al., 2007; Navajas et al., 2000). Initially, sustainability in microfinance is measured by the same yardstick with traditional financial institutions, i.e. by using traditional financial performance ratios such as profit margin, return on assets, return on equity, operating expense over loan portfolio; in MIX Market it is also measured by financial self-sufficiency and operational self-sufficiency (Balkenhol, 2007; Quayes, 2012), as it was translated as how microfinance can generate enough return to cover all its costs.

However, this definition may not befitting microfinance programme run by not-for-profit NGOs, especially development NGOs working in disaster-stricken and war-torn areas. Therefore, many alternative definitions for sustainability had been offered. Among others, one plausible alternative is suggested by Nanayakkara (2012, p. 94), who defined sustainability for microfinance specifically as "a combination of generating its own funds from profitability and its ability to attract external concessional funds on a long-term basis", since not all microfinance put profitability as major concern and many not-for-profit MFIs sustain their operation by external grants from donors. In order to fulfil its mission as poverty alleviation instrument, MFIs have to operate long enough to make impact to its borrower's life. Consequently, sustainability is important element of microfinance. In this study, microfinance sustainability is defined as per the latter definition.

II.3.2.3. Trade-off between Outreach and Sustainability

As briefly presented in Section I.1.4 above, providing financial assistance to the poor often incurs high transaction costs. Transaction costs include all costs pertaining to the operation of MFI in delivering its services to the borrowers, e.g. fixed costs, transportation costs, documentation costs, personnel costs and so on. These costs are high since MFIs deliver loans in relatively small amounts whilst the costs incurred are the same with larger loans. Moreover, when microfinance target poorest customer, these costs increase further due to additional two factors (Diop et al., 2007); firstly, the poor often live in very rural, isolated, hard-to-reach areas lacking adequate infrastructure and services. This will make loans provision and administration costly. Secondly, the use of group lending as loan method to administer the risks from collateral-free lending can raise these costs as well. As will be discussed further in Section II.2.3.1 later, the provision of loans through group lending also incurred costs of regular meetings and trainings to equip the poor. Paxton and Cuevas (2002) similarly conclude that administrative, monitoring and operational costs in lending small loans are a major source of high transaction costs for microfinance loans.

Another reason why transaction costs is higher when the poorest are targeted is because convincing them to take part of MFI programme in the first place thereafter keeping them as clients requires extra time and monetary efforts (Diop et al., 2007). It may seem difficult to understand why the poorest are often reclusive and reluctant to partake even when the financial access is made available to them through microfinance. However, this risk avoidance is actually a rational behaviour when one is in condition of deprivation; it is part of their survival strategy in order to not risking what they already have hence self-exclusion and 'protectionist' (Comim, 2007; Mosley & Rock, 2004). The main reason for this behaviour is the lack of self-confidence from the poor in their ability to partake in the credit programme (Ciravegna, 2005; Simanowitz, 1999).

Financial performance of MFIs focusing on poorest clientele is inevitably affected by these additional costs, which creates additional constraints for MFIs. As MFIs need to achieve financial sustainability, they need to keep manage their costs. Yet, reaching the poorest requires extra efforts hence costly. Indeed, Schreiner (2002) stated that the depth of outreach and financial sustainability are like conflicting objectives: outreach could only attained by sacrificing financial sustainability since focusing on outreach may affect financial performance. Similarly, Morduch (1999) also argue that financial objective of MFIs to strive for sustainability has inverse relationship with their drive to assist the poorest fighting poverty. Many studies, e.g. von Pischke (1996), Olivares-polanco (2005), Mersland and Strøm (2008), Manos and Yaron (2009), Hermes and Lensink (2011), Hermes et al. (2011), Hartarska et al. (2013) and numerous others, also observe the existence of this notion. These studies thus suggest that a trade-off exists between outreach and financial sustainability.

Due to this trade-off and intention of reaching sustainability, many studies recorded that MFIs are unable to reach the poorest of the poor. As early as 1996, Hulme and Mosley (1996) had argued that microfinance did a good job in reducing poverty, but it mostly targeted the less poor just below the poverty line, or based on the taxonomy of poverty condition discussed in Section II.1.2 above to be those in usually poor and churning poor level. Simanowitz (1999) also noted that sustainability target and inability to invest more staffs' time to train clients often constrained MFIs from serving the poorest. Navajas et al. (2000) find that due to this trade-off, MFIs eventually provide credit to households that are either just below the poverty line, dubbed 'the richest of the poor', or those that are just above the poverty line, dubbed 'the poorest of the rich', in its strive to be profitable. Thus, Cull et al. (2007) suggest that since MFIs face trade-off of outreach and sustainability, they can only maintain these two objectives in balance by focusing on the breadth of outreach, i.e. by not focusing to those in absolute poverty or the always poor (depth of outreach) but focusing on spreading loans to the less poor or entrepreneurial poor, e.g. the usually and churning poor (focusing on the breadth of outreach). What these authors in latter work suggest is by assisting the less poor and entrepreneurial poor to improve their livelihoods, the ripple-down effect in the economy will eventually help the poorest of the poor.

II.3.2.4. Different Approaches to Microfinance

The trade-off between financial sustainability and outreach prompts different approaches to microfinance which are recorded in many literatures, among others in Robinson (2001), Bhatt and Tang (2001), Schreiner (2002), Olivares-polanco (2005), Louis et al. (2013), Piot-Lepetit and Nzongang (2014). These different approaches can be viewed as continuum, with different approaches on either end and middle approach that attempts to achieve balance between two extremities of the spectrum.

On one end of the spectrum, there are those who believe in the abovementioned ripple effect, whereby microfinance programme is advocated to aim for the empowerment of productive capabilities and capacities of the less poor, working poor, or entrepreneurial poor in order to create small microenterprises and to create jobs; this in turn would strengthen the economy and induce positive economic impacts that can benefit the entire population including the poorest of the poor. The proponents of this approach argue that large sustainable MFIs would eventually be able to assist more poor borrowers than MFIs focusing on the poorest (Woller, 2007). This approach is commonly termed as *institutionalist* approach; whilst Schreiner (2002) refers to this as *self-sustainability* approach. Thus the emphasis is on financial sustainability as a way for MFIs to achieve permanence, i.e. to remain in their operation for long term.

On the other extreme, there are those who prefer microfinance to specifically target the poorest of the poor, even if it is difficult and costly. Microfinance is urged to stay consistent to its *raison d'être* of poverty alleviation and focus on the poorest; as success is evaluated by the extent to which microfinance caters to the poorest in the short term (Schreiner, 2002). The proponents of this approach uphold that sustainability is attainable without heavily emphasises for institutionalist concept of financial self-sufficiency (Morduch, 2000). Stressing on achieving financial self-sufficiency may cause a mission drift, i.e. MFIs abandon the poorest that needed assistance the most for less poor and relatively well-off poor since they are less risky, less costly and more profitable (Woller, 2007). Herein, donation is regarded to be a part of equity; as such, donors are expected to accept lower financial return as they are considered as social investors, rather than business investors, who instead aiming for intrinsic returns (Piot-Lepetit & Nzongang, 2014). Thus, the focus is on how far MFIs can reach and help the poorest of the poor rather than quantity, i.e. reaching out to large number of borrowers (Brau & Woller, 2004). This approach is commonly termed as *welfarist* approach; whilst Schreiner (2002) refers it as *poverty* approach.

The difference between those two extreme approaches was referred to in microfinance literatures as 'microfinance schism' (Morduch, 2000). Alternatively, some have proposed the middle way between these two extreme approaches. Simanowitz (2007) states that a balance between double bottom objectives in some situations is attainable by setting appropriate strategy for MFIs, such as focusing on women borrower as women is perceived to be poorer than men whilst striving for sustainability; thus, the trade-off can and should be managed. Paxton and Cuevas (2002) argue that the administrative, monitoring and operational costs in lending small loans, i.e. a major source of high transaction costs and trade-off with financial self-sufficiency, could actually be lowered by administering group loan schemes. This is because structure of small loans tends to be similar hence minimising documentation costs. Peer monitoring within group would also reduce the asymmetry information costs; an opinion also supported by Stiglitz (1990). Cassar et al. (2007), Ahlin and Townsend (2007), and also Karlan (2007) using quantitative modelling present fresh acumens on how group lending boosts repayment, which in turn boosts sustainability to manage trade-off in microfinance. Moreover, Miyashita (2000) and Cull et al. (2007) stresses on the importance of MFI strategy formulation and credit design to manage this trade-off. Indeed, much earlier Yaron (1994) had stated that there were model MFIs that could reach these two measures successfully in Thailand and Indonesia.

On the other hand, quantitative microfinance performance studies using frontier efficiency methods of DEA argue that since performance of an MFI measured by its efficiency is essentially a relative concept, i.e. how an MFI perform in comparison to the best practice in industry, then principally achieving relative deep outreach and relative high sustainability is attainable. Indeed, many DEA MFI studies, e.g. from Haq et al. (2010), Fluckiger & Vassiliev (2007), Bassem (2008), Sedzro and Keita (2009), and Gutiérrez-Nieto et al. (2009) and many others, of MFIs across Africa, Central and Eastern Europe, Asia and Latin America observe that both objectives of outreach and financial sustainability can both be pursued in best-practice MFIs. This thesis therefore concurs with this argument and upholds further that high relative performance of outreach and sustainability can be emulated by MFI by following the example of best-performing MFI(s) that share similar characteristics.

II.3.3. Microfinance Loan Methodologies

In providing its financial services to its clients, there are different loan methodologies that can be chosen by an MFI. Three basic loan methodologies that are used by MFIs are presented below. In practice, MFI may offer one of these methods exclusively or offer two and even all of these methods to its clients.

II.3.3.1. Group Lending with Joint Liability

Group lending scheme is pioneered by Grameen Bank in 1976 in Bangladesh. In this scheme, borrowers voluntarily form a small group whereby group members are jointly liable for each other's loan; all members are barred from access to future loans if there is non-repayment from one member (Ghatak & Guinnane, 1999), i.e. termed as dynamic incentives (Kono & Takahashi, 2010). This provides mutual and morally binding guarantees in lieu of collateral through a peer guarantee mechanism, i.e. group members motivate and monitor each other whilst implant social sanctions to non-compliant members (Anthony, 2005). Thus, credit risk is spread among borrowers who are motivated to do a timely repayment through group's peer pressure (Dusuki, 2008a). Moreover, it places an incentives for group members to voluntarily assist potential defaulter to repay the loan (Abdul Rahman, 2007).

As previously discussed, mainstream financial institutions are reluctant to lend to the poor due to disproportionately high information costs relative to loan size since risk profiles of borrowers prior to loan disbursement cannot be assessed accurately, i.e. *ex ante* adverse selection, or loan use may be diverted from what is agreed upon, i.e. *ex post* moral hazard (Hermes & Lensink, 2007). Group lending is able to lower these information costs, mitigating ex ante and ex post problems by providing clear incentives to group members to screen and monitor each other (Stiglitz, 1990). It is effective and inexpensive since members of the same group know each other and often live next door to each other

(Armendariz de Aghion & Morduch, 2005; Hermes & Lensink, 2007). Its effectiveness had been shown by Grameen Bank in 98% repayment rate thereby replicated globally (Anthony, 2005). Moreover, group-based lending creates social capital and enables groups to achieve wider social objective (Gomez & Santor, 2001; Rankin, 2002). It is regarded as the best loan method in microfinance (Armendariz de Aghion & Morduch, 2005; Kono & Takahashi, 2010).

On the contrary, critics argued that this very mechanism may induce agency problem that ironically omit the poorest from gaining access to microcredit, i.e. excluded by group members in group formation as not deemed creditworthy hence risky (Marr, 2003) or deliberately rejected by MFI loan officer in group lending to avoid delinquency (Hulme & Mosley, 1996). Problem also arises related to high transaction costs due to regular meeting requirement especially if borrowers do not live close to each other causing interest rates to increase (Shankar, 2007), and limited loan amount that can be jointly guaranteed by the group curbs borrowers with growing business (Armendáriz de Aghion & Morduch, 2000; Madajewicz, 2011). This high transaction costs would often raise the interest rates charged to borrowers above the usury rates, thereby making the underprivileged to ironically pay more for financial access. Even though some defend this by arguing that the credit access opportunity could justify the fact that the poor have to pay more, it attracts criticism to the practice nonetheless (Diop et al., 2007). Moreover, whilst repayment is theoretically enhanced by exploiting local information (Ghatak, 2000), repayment is empirically found to be enhanced only by social homogeneity and personal trust exist between members (Cassar et al., 2007; Karlan, 2007).

II.3.3.2. Individual-based Lending

Individual-based lending scheme is a bilateral loan agreement between MFI and sole borrower, as applied in traditional financial institutions, whereby loan is extended to individual based on her creditworthiness and usually backed by collateral (Dellien et al., 2005). Collateral needed may be in the form of tangible assets such as livestock and house, e.g. in some Albanian MFIs, or assets having personal value for borrower without emphasise on salvage value, e.g. in Russian MFIs. Novel method of screening was done prior to loan allocation, ranging from staff visits to applicants' businesses and homes to loan guarantee and character reference from member of local village committee (Armendáriz de Aghion & Morduch, 2000; Churchill, 1999). As in group lending, dynamic incentives is also utilised to overcome ex post moral hazard and strategic default, i.e. borrowers lend with the intention not to repay the loan (Hermes & Lensink, 2007; Kono & Takahashi, 2010).

Armendáriz de Aghion and Morduch (2000) argued that in the relatively industrialized area and in transition economies, individual lending befits more than group lending, since it is not restricting borrowers with growing businesses. Repayment rate is enhanced by securing collateral and implementing dynamic incentives as MFIs are capable to find novel way to gather information, monitoring and enforcing contracts.

Individual lending method is also observed in literatures to have lower transaction costs than other methods, with further flexibility in loan start date and amount, plus the absence of obligation to guarantee loan of other people as in group lending and village banking (Westley, 2004). It is the method used by banks and non-bank financial institutions (NBFIs) in Latin America (Servin et al., 2012) and also widely used in East Asia (Cull et al., 2007) and the Middle East (Abdelkader et al., 2012). Even group lending pioneer Grameen Bank in Bangladesh had added individual lending into its loan offerings, whilst other giants like ASA in Bangladesh and BancoSol in Bolivia switched completely into individual lending method and discontinued their group offerings (Armendariz de Aghion & Morduch, 2005; Cull et al., 2007).

Nevertheless, individual lending method is found to have lower outreach to borrowers as collateral requirement deters poorest borrowers; individual lending method is more often appealed to the less poor and entrepreneurial poor, i.e. those, based on the poverty level taxonomy, who are in level of usually poor, churning poor, and the occasionally poor (Hermes et al., 2011; Navajas et al., 2000). Thus attracting better-off clients in large MFIs with individual lending is often done at the expense of poorest borrowers, i.e. *mission drift* (Armendariz & Szafarz, 2011; Cull et al., 2007).

II.3.3.3. Village Banking scheme

In Latin America, FINCA International pioneered village banking scheme; establishing access to credits and savings through community-managed associations typically set up at the village level – 'village bank' – consisting about 30 – 50 members. This scheme is usually arranged by non-governmental organizations (NGOs), which as sponsoring agency facilitate external capital for subsequent financing to village bank members from local commercial banks. This financing is commonly tied to member's deposit in the village bank (Morduch, 1999). Akin to group lending, peer pressure mechanism is implemented herewith, ensuring timely loan repayment to village bank sponsors which further assuring external capital injections. Differences with group lending are village bank adopts bylaws, elects president and treasurer, and manages its members' loans and savings independently. It mostly retains internal accounts from savings and time gap in interest and principal payment to its sponsors that can be extended as extra loans (Westley, 2004). The goal is to accumulate capital internally so as to graduate as an autonomous self-sustaining financial unit in three years (Morduch, 1999; Obaidullah, 2008a).

Compared to other schemes, village banking have greater rural focus and lower average loan balance (Westley, 2004) and, like group lending, more associated with poorer borrowers (Hermes et al., 2011). This model has been replicated mainly in Latin America and Africa (Obaidullah, 2008a). However, the transaction costs is higher for this scheme compared to other methods owing to self-management and compulsory attendance at village banks meetings, thus the real benefit lies for borrowers in the savings and non-financial services rather than being an efficient credit facilitators. Inflexible loan start date, capped loan amount, and forced saving requirement are often problematic to growing micro-entrepreneurs (Westley, 2004). Moreover, original target to transform into independent financial provider in three year time is often delayed due to slow savings and growing credit demands (Morduch, 1999).

II.3.4. Critiques on Microfinance Practice

Whilst hailed as effective approach to poverty alleviation effort with huge success in extensive literatures, critics cited failures of MFIs in delivering some of their objectives as in the following:

1. Credit Misuse Problems

Although MFI loan were extended to women borrowers in the hope to empower them, many studies found that it was men head of the households that initiate the decision to take loans and to control the usage of funds borrowed by women members of MFIs, thus manipulating women members to get credit from MFIs, e.g. in Chowdhury and Mukhopadhaya (2012), Karim and Osada (1998), and Pretes (2002). Since it is the women member of household that were responsible for the repayment of the credit hence increasing tension in the family (Rahman, 1999). Women member in the household will be the sole signatory of the loan contract thus solely accountable for the repayment of the loan disbursed. Consequently, tension, frustration and even domestic violence exacerbate in the household if women receiver of the loans were not the end user of the said loan.

Another type of loan misuse are cases reported in many studies, among others in Chowdhury and Mukhopadhaya (2012), Revolledo-wright (2004), Mosley (1998), and Dichter (1996), whereby credit intended for productive use was later misused mainly for consumption hence increases default possibility.

2. Economic Viability of MFI

Many MFIs are found to be unviable as a result of high administrative costs and lack of fund mobilization (Khandker, 1996). Khandker et al. (1994) had pointed out earlier that Grameen Bank's book appeared in blue as it treated grant and subsidy as revenue hence able to keep revenue above expenditure; whilst Hashemi et al. (1996) analyzed using Subsidy Dependence Index (SDI) that Grameen Bank would have to increase its interest rate by an additional 21 percent in 1996 so that it can reach break-even without relying on grants.

3. Low Return On Investment (ROI)

As a result of the loan diversion onto consumption and asset purchases often done by the poorest in chronic poverty, the overall ROI of MFIs are lower (Ahmed, 2002). On the other hand, Vogelgesang (2003) observed that with a sudden availability of several different MFIs in previously marginalised communities in a particular area and with the absence of proper direction, different borrowing groups sprang up in the same area which would then engage in the same business activities hence raising competitions and lowers the ROI of the borrowers and MFIs.

4. Exclusion of the Poor, high drop-out rate and non-graduation from poverty

MFIs are found in studies to cease from serving the poorest community who were either excluded from loan access due to objection by other group members dreading repayment risk (Comim, 2007; Evans et al., 1999) or dropped out of the credit schemes due to inability to repay the loan (Karim & Osada, 1998; Shaw, 2004; Simanowitz, 1999). Navajas et al. (2000) reported that in Bolivia, MFIs operation had only touched either 'the richest of the poor' or 'the poorest of the rich', i.e. those slightly below or slightly above the poverty lines. These are the segments referred to by Sen (1981) as usually poor and churning poor (and sometimes the occasionally poor) or referred to in various microfinance literatures as less poor, working poor or entrepreneurial poor as per discussion in Section II.2.2. Furthermore, Karim and Osada (1998) reported that there was steady rise in dropout rate from Grameen Bank and 88% of those dropouts did not graduate to the non-poor status.

Another reason as to why the poorest may be excluded from microfinance programme is due to self-reclusiveness; microfinance often fails or is reluctant to invest time and effort to approach the poorest who are hesitant to join the programme due to the lack of self-confidence. As previously discussed in Section II.2.2.3, this is actually part of the rational behaviour that the poorest have lack of confidence to partake in activities that entails any failure risks (Ciravegna, 2005; Simanowitz, 1999).

5. Debt trap

Rahman (1999) observed that to pay for instalments Grameen Bank borrowers often take loans from other lenders, effectively trapping them in spiralling debt. He also found that conditions where poor borrowers have to liquidate any assets they have to pay for the interest are uncommon, which is also reported in Obaidullah and Mohamed-Saleem (2008) and Pretes (2002). Vogelgesang (2003) also pointed out that the rising competition among different borrower groups in the same area raised the indebtedness and often put borrowers in spiralling debt trap.

6. Increased disparities

Microfinance programme may increase disparities amongst the different segment of underprivileged people in these three conditions, i.e. over-indebtedness, usage of savings of the poorest to finance microentreprises, and MFI deliberate focus on micro-entrepreneurship (Diop et al., 2007). Over-indebtedness often happen when there are several MFIs 'competing' for borrowers in the same area; a borrower goes to various MFIs due to ease of joining to take loan from one MFI and use it to repay another loan from another MFI. Another scenario happens when borrowers take several loans from various MFIs simultaneously more than their ability to repay. These two scenarios often drown the poorest into inability to repay the loans.

Secondly, when MFIs are allowed to use members' savings to extend extra loans, MFIs tend to use this to extend larger loans to micro-entrepreneur or entrepreneurial poor. This means that the savings of the poorest are used to enhance the less poor hence widen the disparity. Similarly, when MFIs intentionally focus on entrepreneurial poor, e.g. by switching to individual loans which requires collateral or by raising the minimum amounts of loans, the poorest will again be left out. This will be described more thoroughly in point no. 8 below.

Targeting solely women borrower is also observed to be a source of another problem: increased disparities among women borrowers themselves. There are inevitably different social tier between women members of one community; if microfinance programme favours the less poor and the working poor more (under institutionalist approach) then the wealth disparity between these segments and the chronic poor will be wider; this is exacerbated by the fact that the ripple effect may not be working in all situations.

7. **Loan deduction at disbursement**

At loan disbursement, MFIs are reported to deduct some amount from principal for group or emergency fund but still charging interest for the full principal amount extended (Ahmed, 2002). This eventually raises the effective loan interest rates from their already high nominal interest rates.

8. **Mission drift**

Group lending is a unique feature of microfinance praised for its ability to create social capital and social guarantee in lieu of physical collateral. However, some MFIs are now abandoning group lending scheme as perceived to be costly and switch into individual lending just like conventional banking, including Grameen Bank in Bangladesh in 2002 and Banco Sol in Bolivia (Cull, Demirguc-Kunt, & Morduch, 2007; Servin et al., 2012). Consequently, some of these MFIs are now focusing on bigger loan size, demanding collaterals and, automatically, imposing self-selection on the borrowers by focusing on less poor and entrepreneurial poor. Thus, when MFIs completely leave out the poorest by this self-selection mechanism, a phenomenon of 'mission drift' happen whereby MFIs abandon the poorest in favour of more promising less poor segment (Armendariz & Szafarz, 2011; James Copestake, 2007; Helms, 2006; Kono & Takahashi, 2010; Smith et al., 2007).

9. **Usurious interest rates**

As previously discussed at length at Section I.1.2, due to the transaction costs in providing the financial access to the poorest, MFIs often compensate this by charging high interest rates, which in many cases often surpassing the usurious rates (Diop et al., 2007; Parveen, 2009).

II.4. Islamic Microfinance

II.4.1. Concept of Islamic Microfinance

The modern concept of Islamic banking and finance has been developed since the mid-1970s (Ahmed, 2002), highlights a central concept of prohibition of *Riba* (usury/interest) in all its forms and intentions as prescribed in the Islamic law. It is intended to enable Muslim communities in need of financing to engage in essential business and financial activities without compromising their beliefs, i.e. the focal point being the compliance of Islamic prohibition of usurious or interest-based transactions. Profit and loss sharing (PLS) and other Islamic banking contracts were utilised in lieu of interest.

As alternative to interest-based loans, Islamic microfinance scheme were developed later in the 1990s. When IMFIs first developed, they used Islamic microfinance scheme based on Grameen bank's group lending, yet later they use individual lending scheme as well (Obaidullah & Abdul Latiff, 2008; Obaidullah, 2008a). As their conventional counterparts, IMFIs also extend social development programme whilst modifies the scheme to comply to Islamic prohibition of interest by theoretically providing interest-free deposits and loans in lieu of interest-based ones. Herein, Islamic microfinance scheme uses *Shari'a* -compliant contracts in structuring its financing and deposit model (Khan & Phillips, 2010; Segrado, 2005; Seibel & Agung, 2006). These contracts will be discussed in details in Section II.3.3 below.

II.4.2. Theoretical Differences between Islamic and Conventional Microfinance

The summary of some theoretical differences between these Islamic and conventional microfinance as presented below.

1. Sources of funds

On the liability side, other than having access to the traditional access of funding from donors, government and central bank just like MFIs, IMFIs can have access of funds from Islamic religious institutions of *zakat* (alms), *infaq* (charity) and *waqf* (endowment), which represent the social financial intermediation of IMFIs (Ahmed, 2002; Wilson, 2007).

2. Modes of financing

The asset side of IMFIs comprises of different Islamic modes of financing based on profit-loss sharing and other interest-free basis. The important features of these are that in its original forms, transactions must involve a real object or goods and financial capital cannot claim return on itself. Loans are extended in the form of goods in lieu of cash (Ahmed, 2007; Obaidullah, 2008a; Wilson, 2007).

3. Financing the poorest of the poor

As previously discussed, in many cases the poorest of the poor section could not be served by MFIs, as condition of extreme poverty often lead to misuse of productive loan into consumption and asset purchases, as the poorest of the poor tempted to satisfy their basic needs first. IMFIs principally can overcome this problem by combining *zakat* (compulsory alms) and *shadaqah* (voluntary charity) from religious institution to the poorest of the poor to fulfil their basic needs whilst providing access to productive loans (Ahmed, 2002; Wilson, 2007).

4. Net amount received during loan disbursement

As stated previously, part of the loan extended by MFIs is deducted for group and emergency funds whilst interest is still being charged on the total principal extended, rising the effective interest rate even higher. Besides prohibited by Islamic law, it is not possible for IMFIs to take deduction as loan is supposed to be extended to beneficiaries in the form of productive goods not cash (Abdul Rahman, 2007; Ahmed, 2002).

5. Group dynamics

Group guarantee in loan repayment to IMFIs may take the form of *kafalah* (representation) that makes group members guarantors for loan repayment. If any member was unable to make repayment, theoretically other members of the group must agree to assist; using *qard al-hasan* (interest-free compassionate loan) to assist the member facing the problem (Ahmed, 2002; Dusuki, 2008a).

6. Islamically-driven social development programme

Whilst social development programmes extended by MFIs have a secular and sometimes even contradict to Islamic teaching, such programmes provided by IMFIs have Islamically-influenced contents; providing benefits such as provides compatibility with borrowers' values and beliefs and builds feeling of social comradeship and religious accountability that beneficial in loan repayment, i.e. making loan repayment is religious responsibility (Ahmed, 2002; Dusuki, 2008b; Obaidullah, 2008b).

7. Family borrower vs women borrower

Despite of the fact that majority of IMFIs beneficiary are women, there is a fundamental differences in the objective with that of MFIs. IMFIs are targeting family as the beneficiary of the loan thus the loan contract are signed by the women and her spouse in the family hence make them both liable for repayment. IMFIs deal with women for efficiency as it is easier for women to attend the weekly meeting and to disseminate the Islamic teachings to all members of the family (Abdul Rahman, 2007; Ahmed, 2002).

8. Staff work incentives

As staffs are also equipped with prior religious knowledge and expected to educate the borrowers in religious knowledge on top of social and entrepreneurial skills, incentive for IMFIs staff members encompasses a mere economic motive but also religious duty (Dusuki, 2008a).

9. Dealing with Default

MFIs uses group and centre pressure in dealing with repayment default and arrears. Ahmed (2002:40) reported that if this fails 'sometimes threats are made and in extreme cases assets are sold', which is also reported in Parveen (2009) and Pretes (2002). On the other hand, the spirit of brotherhood and religious ties created in IMFIs environment theoretically encourage group members and centres to help the paying the defaulted amount. Spouses of the members are also encouraged to be approached (Dusuki, 2008b).

II.4.3. Financing Modes in Islamic Microfinance

In structuring its financing facilities to its borrowers, IMFIs employ some of the Islamic financing modes that are implemented in other Islamic financial institutions; these can be summarised and redrawn from Smolo and Ismail (2011), El Diwany (2010), Abdul-Rahman (2010) and Allen & Overy LLP (2009) in the following:

1. Profit-sharing modes

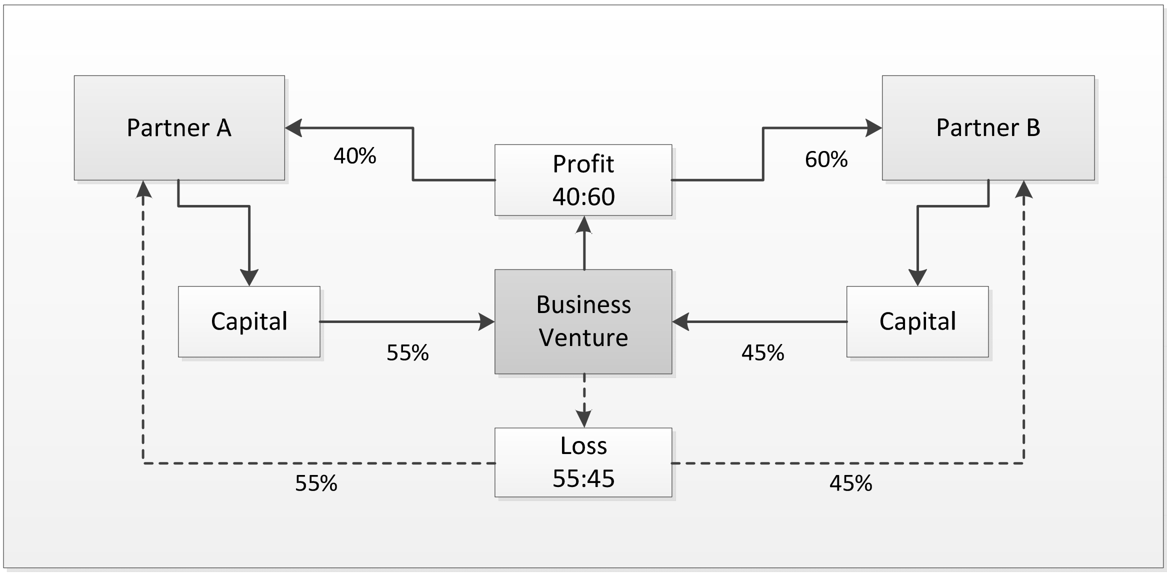
Two financing modes that falls into this criterion are as follow:

(a) *Mushārakah* (partnership)

Mushārakah is a partnership contract between two or more investors or parties to invest in project or business venture whereby capital injection, profit, and loss are shared. These parties will contribute to the initial capital. Profits then will be shared according to prearranged ratios between all investors; yet losses will be shared exactly in the proportion of capital injected by each investor into the venture. All parties have rights to the management of the venture even though some may opt not to participate in the management hence the possible differences in the ratio of profit-sharing ratio from that of capital injection.

The graphical schematic of this financing mode is presented in Figure 2.1. In this figure A and B create a partnership together where A and B inject 55% and 45% to the capital, respectively. They agreed upon to a profit-sharing ratio of 40:60 for A and B, respectively since B will be more active in managing the ventures. Profit arising herein will be shared 40:60 between A and B, respectively; yet losses will be shared 55:45 as in the capital injection proportion.

Figure 2.1: Mushārakah (Partnership)



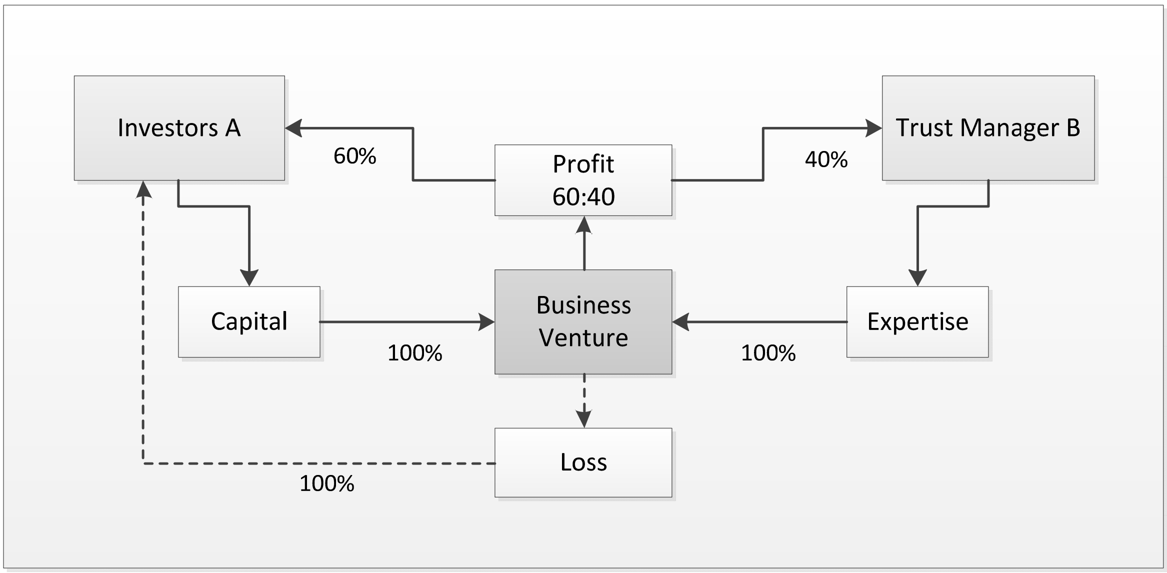
Source: summarises and redrawn by Author from various literatures

(b) *Mudhārabah* (trust financing)

Mudhārabah is a trust financing agreement whereby one or more investor(s), termed *rabb al-māl* (owner of capital) inject capital to a venture, whilst another party with fiduciary responsibility, termed *mudārib*, provides time and managerial expertise in managing the said venture. The ownership of this venture is owned by the investors yet the management rights are retained by the trust manager. Profit herein will be shared between investors and the manager according to the proportion that have been mutually agreed upon, whilst trust manager is not receiving salary except for the proportion of the profit. However, any losses will only be borne by investors, except in the case where the cause thereof is the gross negligence of or violation of contract from the trust manager.

Figure 2.2 depicts the schematic structure of a mudhārabah contract, where a group of investors A contribute 100% capital to a business venture whilst trust manager B provides managerial expertise to run this venture. Investors A and manager B agree on a profit-sharing ratio of 60:40 thus profit is shared accordingly. In the event of loss, 100% of losses will be borne by investors, which will eventually share this loss between them according to their contribution.

Figure 2.2: Mudhārabah (Trust Financing)



Source: summarises and redrawn by Author from various literatures

In regard to financing, the abovementioned financing modes are the highlights of Islamic finance. This is because on these modes, the financial returns are earned subject to the successful performance of the business venture; there is no predetermined or promised exact return on both investors and managers (on mudhārabah) or on all partners (on mushārakah) apart from just profit-sharing ratio; whatever profit that the venture make will be shared accordingly. Loss is not shared in mudhārabah because investors are silent partner, i.e. they do not invest time in the operation of the venture, whilst trust manager had invested his time in running the venture without any salary. Yet, if the loss is due to the negligence of the trust manager, he has to share the loss as well. These modes highlight the Islamic finance's alternative in promoting economic and social justice (El Diwany, 2010). Mushārakah is often used in joint venture and venture capital; whilst mudhārabah is often applied in fund management.

Nevertheless, in the microfinance context, these two financing modes are not implemented widely as they are perceived as troublesome; borrowers need to prepare detailed reporting whilst it is considered as additional costs to those that are not familiar to formal accounting reporting.

2. Contract of exchange

Several financing modes that can be classified in this category are as follow:

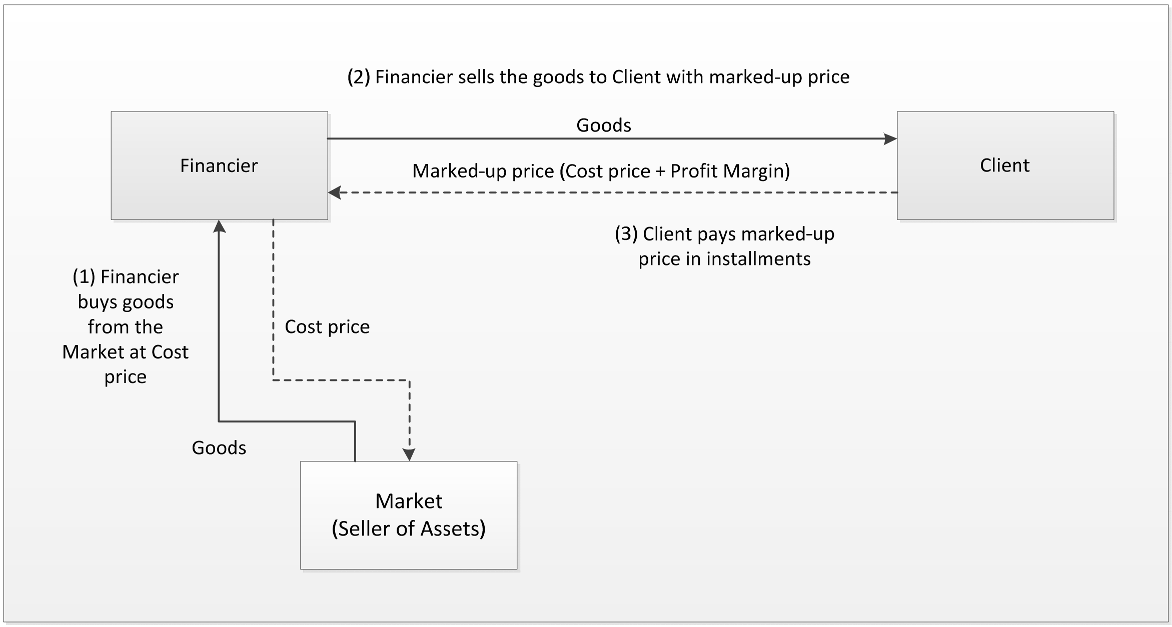
(a) *Murābahah* (cost-plus trade financing)

Murābahah is literally a sale on profit whilst it is technically means a sale contract where the seller discloses his cost and profit. In terms of financing, it is essentially a trade financing mechanism where a financier helps a client by purchasing tangible assets from the market and selling them to the client with a predetermined profit margin. The financier discloses to the client the cost and the profit margin, which needs to be approved by the client. The tangible assets then will be sold to the client at the price equal that is equal to cost plus profit margin. When the client pay in deferred payments (by instalments), as is usually the case, this mechanism can also be termed *bay' al-muajjal* or *bay' bithaman ājil*, or deferred payment sale.

As can be understood from description above, this scheme is intended to help a venture or a business to start by helping them acquiring the necessary productive tangible assets for the operation, which can be paid for in instalments. The key in this scheme is that it is essentially an in-kind financing, not monetary; also the profit margin charged needs to be mutually agreed upon by financier and client. As previously mentioned, it is mostly used in trade financing transaction. The structure of murābahah contract is presented in Figure 2.3. In this illustration, the financier helps the client buys productive goods at market at cost price thereafter sells it at marked-up price. The client pays marked-up price with instalments, as it usually the case in practice.

In the context of microfinance, murābahah is actually the most widely used schemes, due to its flexibility and resemblance to the conventional scheme due to its cost plus margin price (Allen & Overy LLP, 2009; El Diwany, 2010). Yet, many *Shari'a* (Islamic law) scholars have expressed their concern upon how it is commonly practiced in the field, since many MFIs eventually extends the financing in monetary form instead of in-kind since it is perceived to be costly, thereby violating its original form. The end result by using monetary form deemed to be similar with that of conventional scheme, thus prone to fungible loan misuse that supposed to be avoided (Ahmed, 2002).

Figure 2.3: ***Murābahah*** **with** ***Bay' al-Muajjal*** **(Trade Financing with Deferred Payment)**

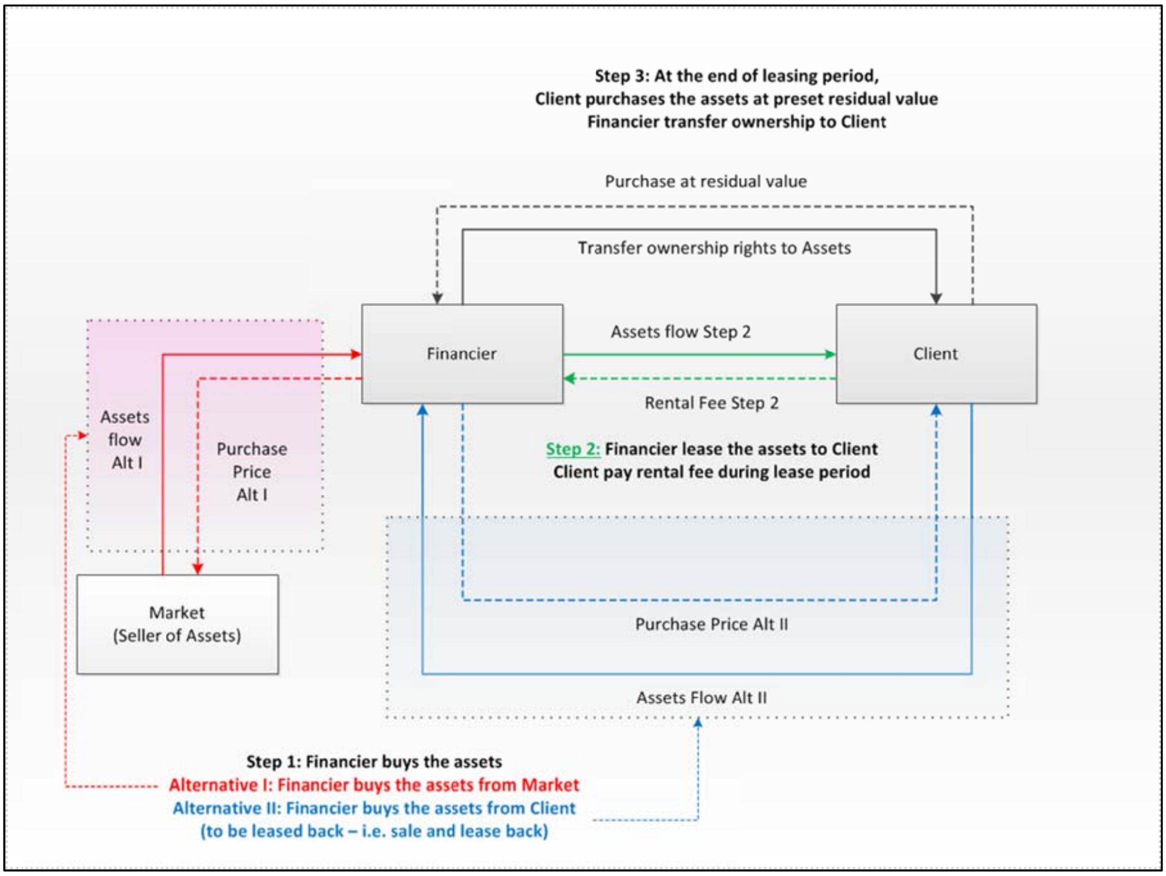


Source: summarises and redrawn by Author from various literatures

(b) *Ijārah* (leasing)

This contract is an agreement in which a financier purchase a productive assets such as building, machinery, tractor, sewing machine, handicraft equipment or other facility thereafter leases it to a client for a mutually agreed upon period of lease. The client pays *ijārah* fee (rental fee) during those periods. The asset can be purchased from market or can be purchased from the client to be leased back to them (sale and lease back). The ownership of the asset in the period of leasing remains with the financier but the *usufruct* is transferred to the client as the lessee. Usually at the end of the leasing period, the client can purchase the asset (with purchase undertaking) or the financier can sell the asset (with sale undertaking) at predetermined residual market value of the asset or with predetermined formula (*ijārah wa iqtinā* or lease to purchase). Asset value can also be structured in such a way into ijārah fee so that at the maturity of the leasing period the asset ownership would merely be transferred to the client. This scheme, more specifically lease to purchase (ijārah wa iqtinā) is illustrated in Figure 2.4.

Figure 2.4: ***Ijārah wa iqtinā*** **(lease to purchase)**



Source: summarises and redrawn by Author from various literatures

In the microfinance context, this scheme is used to extend in-kind financing, such as leasing of farm machinery, sewing machine, stove, handicraft tools, and other assets. Herein, this scheme is not used in sale and lease back mechanism as poor borrowers more often lacking equipment to start their venture in the first place.

3. *Qard al-hasan* (benevolent loan)

Qard al-hasan is a loan that is extended to poor borrowers with charitable intention to assist the poor in fulfilling their basic needs or in meeting short-term funding requirements. It is completely interest-free and the beneficiaries are only required to repay the loan principal at maturity. In the microfinance context, most IMFIs use this loan to assist the poorest in their welfare so as to avoid productive loan misuse. However, several

NGO-based IMFIs, such as Akhuwat in Pakistan, use this scheme exclusively in their loan offerings so that the borrowers are not charged even profit margin. These NGO-IMFIs survive from donation; yet in the case of Akhuwat, interestingly they can sustain their operation without assistance from international donor organisations or financial institution (Obaidullah, 2008a).

II.4.4. Critiques of Islamic Microfinance Practice

Theoretically, Islamic microfinance was structured to provide better business model than that of conventional MFIs. However, criticisms are drawn from its practice as presented below:

1. Dilution in application of Islamic financing modes

Ahmed (2002) observed in the field that many IMFIs operatives extend financing in the form of cash instead of goods due to cost concern, i.e. it is perceived as too costly in terms of man hours to purchase goods needed by beneficiaries. Instead, they delegate someone else to buy the goods/assets. This in turn negates the in-kind lending advantage and opens the door for loan misuse due to loan fungibility as in the case with conventional microfinance.

2. Lack of training for field staff

Observing the sample of the IMFIs in Bangladesh, Ahmed (2002) also found that IMFI field staffs lack proper training in Islamic Financing Modes needed in dealing with beneficiaries' financing needs and in Islamic contents for social development programme extended to the beneficiaries.

3. Over-reliance on Particular Financing Modes

In relation to the lack of training in Islamic financing modes stated above, Abdul Rahman (2007) and Wilson (2007) observed that there is over-reliance on particular financing modes, i.e. *murābahah* (cost-plus-profit) financing with *bay' al-muajjal* (selling transaction with deferred payment). Whilst simplest among other Islamic contracts, this mode has close features with conventional lending scheme thus over-reliance on this mode hinders the exploration of other modes with distinctive Islamic finance characteristics, e.g. *mudhārabah* (profit-sharing) or *mushāraka* (equity-financing). Since this mode has a close features with conventional schemes, it risks masking interest-based lending under the garb of Islamic financing mode which has been a major concern of the Islamic law scholars (Obaidullah, 2011), akin to phenomenon happened in Islamic banking (Chong & Liu, 2009).

4. Lack of funds / unexplored source of funds

Lack of funds is faced by many IMFIs that rely on external funding sources, especially at the initial stages of operation. Islamic content in their social development programme deter access to funds from some donors and government loans that were offered with interest (Ahmed, 2002). IMFIs have opportunity to tapped funds from Islamic charity institutions yet it have not been explored (Wilson, 2007).

II.5. Summary and Discussion

This chapter provides a basic understanding and guidance in microfinance performance measurement. The theory of poverty described at the beginning of this chapter presents insight on different level of poverty, which is imperative to understand to measure the performance of poverty alleviation methodology such as microfinance. Indeed, MFIs face double bottom objectives of financial sustainability and outreach to the poor as they are essentially a portmanteau of financial institution and poverty-alleviation agent. In this regard, the knowledge of different level poverty comes as important in measuring whether an MFI had performed its humanitarian duty of reaching out to the poor, as all MFIs will cite poverty outreach as one of their goals. Yet, they can target different levels of poverty in this attempt, i.e. the chronic poor under the poverty line or the poor that are in and around the poverty line. Therefore, a clear specification of poverty outreach yardstick needs to be established beforehand. On the other hand, financial sustainability in the microfinance context does not restricted to financial profitability as in traditional financial institutions; it instead refers to the ability of MFI to operate without the fear of bankruptcy, of which the role of subsidy becomes imperative.

From empirical studies, many microfinance observers have observed a trade-off between these two objectives, which prompts two approaches to microfinance, i.e. institutionalist approach scholars who favours MFIs to focus on deepening outreach and self-sustainability approach scholars who focus on financial sustainability. However, several MFI studies employing frontier-based efficiency in measuring MFI performance observed that these objectives can be reached concurrently if they are defined as relative measures (i.e. best-performing MFIs amongst all MFIs in dataset). Thus, this study would like to explore this idea in its first and second study, which will be covered in Chapter V and VI respectively in this study, to present alternatives to the dichotomy of outreach and financial sustainability.

Besides having distinctive advantages to raise the poor out of poverty, empirical studies also found that there are several shortcomings in microfinance practical implementation. Amongst these is the prevalence of high interest rates, which is higher than traditional banking system, prompting some observers to question the MFI intention to help the poor out of poverty. Due to this, Islamic microfinance then was developed to offer a non-interest-based alternative to mainstream microfinance. It offers similar services through several distinctive financing options, which was covered in Section II.4.3. However, empirical observations yet again found deviation in its implementation, i.e. some Islamic MFIs actually extend loans similar to the conventional without implementing a distinctive Islamic financing scheme which is conceptually intended to offer solution to the weaknesses of the conventional microfinance. This thus raises question which will be explored in the first study of this research, i.e. whether there are significance differences in performance of Islamic MFIs and conventional MFIs in South Asia, MENA, and East Asia and the Pacific.

On the other hand, the loan extended by MFIs to the poor can basically be categorised into three types: group loan, individual loan, and village banking loan. Whilst early microfinance studies favoured group loan, the latter studies are more varied; each of these loan type have their proponents suggesting that their methodology is the best offering for microfinance. This encourages the second study that is presented in Chapter VI, i.e. observing the relationship of chosen loan methodology to MFI performance. This study is performed using data in six global regions, measuring them globally and in each of their respective regions. The intention is to observe whether regional preference exists, or, from another angle, whether there is single loan method that has absolute advantage over others in boosting MFI performance in all regions.

The final study in Chapter VII will therefore explore the productivity growth of MFIs in six different regions. This is intended to find empirical evidence whether MFIs can show growth in firm-level productivity, or whether the growth of MFI in the last decade was spurred mainly by the growth of industry-level productivity.

Chapter III: Efficiency and Productivity

III.1. Introduction

This chapter provides introduction to the concept of efficiency and productivity from its root in microeconomics, especially from theory of the firm and production theory. Section III.2 describes The Theory of the Firm in brief to provide a conceptual background for this research, i.e. exploring Neoclassical Theory of the Firm, Agency Theory and X-efficiency Theory to explain the evolution of economic thoughts in regard to firm performance; specifically in terms of differences in firm performance and inefficiency since the classical and the neoclassical economic theory assumes that only efficient firms stays in business. Section III.3 visits Production Theory then builds understanding of the basic efficiency concept through the concept of Pareto optimality, the difference between efficiency versus productivity concept, the difference between constant and variable return to scale and the conceptual differences between technical, allocative and cost efficiency. Thereafter, the conceptual decomposition of scale efficiency and pure technical efficiency under the condition of variable returns to scale is introduced. Section III.4 presents the efficiency concept as performance measurement criterion in the microfinance context, especially in the context of this research. Finally, the summary of this chapter is presented in Section III.5.

III.2. Theories of the Firm

III.2.1. Neoclassical Theory of the Firm

As a branch of microeconomics, theory of the firm deals with how firms are using their inputs to produce final goods or tradable goods, i.e. deals with variables involved in the process e.g. price, costs, output, growth, and competition. From the perspective of neoclassical theory of the firm, a firm is regarded as a production unit or production function, which is often personified by its owner-manager-entrepreneur who directs the production process with less in depth focus on its internal mechanism (Mäntysaari, 2012).

More specifically, a firm is treated as a 'black box structure', transforming inputs of production into tradable final goods or services (Jensen & Meckling, 1976). The underlying assumption is that a firm organises production more competently than separate entities working through separate bilateral contracts.

This theory is advocated by a seminal work by Alchian and Demsetz (1972) then later Jensen and Meckling (1976). These works took their roots from classical works in economics by Adam Smith in 1776, which stated firms as coordinator and motivator of all economic activities from specialised society, plus static equilibrium structure from Cournot (1838) and transaction cost theory from Coase (1937), whereas a firm is organised when transaction costs of coordinating production through a firm is lower than that organised separately through market mechanism. In neoclassical theory of the firm, the market is assumed to be perfectly competitive with perfect information.

Alchian and Demsetz (1972) attributed the abovementioned transaction costs to information costs related to measurement and monitoring of outputs. They argue that a firm actually consists of a nexus of contracts with prices attached; a team of production processes exists therewith whose collective output can be measured as opposed to individual contribution. The advantage of a firm as opposed to loose individual contracts is in the role of the owner-manager-entrepreneur as the coordinator of the process, i.e. the central agent is the firm's owner and employer. This central agent role is the basic tenet in neoclassical theory of the firm.

Amongst the basic assumptions of the neoclassical theory of the firm are that firms operate in a perfect competition market, and that they seek profit maximisation by attempting to minimise costs and maximising revenues. In the short run, a firm can gain abnormal profit but this abnormal profit will attract other firms to enter the market to compete, thus drive the price down and lower the profit for each individual firm. Therefore, perfect competition markets lead firms to only earn normal profit (economic profit) sufficient to cover their economic costs, which includes their opportunity costs (Porter, 1979). A firm that is unable to make normal profit due to its inability to allocate resources optimally in the long run will either be driven out of business or be acquired by other firms that can perform more *efficiently*. Thus, efficiency in neoclassical theory of the firm is defined as an ability to allocate resources to produce the maximum level of output to achieve maximum normal profit possible. In addition to this, in the main assumption of perfectly competitive markets with perfect information, firms that fail to operate at the efficient frontier will be driven out of market hence only efficient ones exist.

However, empirical evidences show that there are still inefficient firms operating and surviving in the market. Thus, neoclassical theory of the firm fails to provide explanation of why this phenomenon exists. Secondly, the main assumptions of perfect competition market and perfect information are also challenged by the real world empirics. Different theories therefore have been developed in an attempt to present alternative explanations. Three of these theories that will be presented in the subsequent sections are managerial theory of the firm, agency theory and x-efficiency theory.

III.2.2. Managerial Theory of the Firm

In the modern economy, it has been a common phenomenon that firms, especially large ones, are owned by certain numbers of individual and institutional shareholders who do not engage in day-to-day operation of the firm. There is thus a separation between ownership from managerial/control function in the firm. Consequently, the classical and neoclassical assumption of owner-manager-entrepreneur is perceived to be unrealistic and too restrictive; moreover, this role separation brings with it problems unidentified in firms under control of single owner-manager-entrepreneur. Different theories have been developed to provide alternative explanations. One of these is managerial theory of the firm. It argues that in the case whereby the firm's controlling managers are different than the firm's owner(s), profit maximization is not necessarily the sole objective. Firm managers have different interests and utilities to pursue, albeit subjected by a somewhat profit constraint of the firm. Instances of these interests are personal remuneration, prestige, professional perks and power; i.e. interests that seek to enhance the utilities of the controlling managers.

Consequently, controlling managers' objectives may not be compatible with the owner's objective of firm profit maximisation. This is due to the fact that firm costs may not be minimised in reaching equilibrium of these interests thus organisational slack would be built into the system (Williamson, 1964). Organisational slack is defined as the gap between total resources and the necessary payments, which can be in the form of wages paid in excess of those required, prices that are set lower than what it should be, or higher dividend payout than what perceived to be (Cyert & March, 1963).

Managerial discretion model from Williamson (1964) started out from traditional profit maximising framework, whereby firms produce at the equilibrium or marginal cost and marginal revenue curve (MC = MR). Thereafter, due to separation of ownership from firm control, managers pursue their utility from monetary reward, power and discretionary perks, which in turn increase costs without necessarily increasing profit and lower the dividends paid to shareholders. Thus their constraint herein being the minimum profit required. Therefore, in order to increase profit in the face of rising costs, these rewards should be linked to sales achievement. Managers will thus maximise sales in the short run in order to achieve its objectives of salary, perks, and power, which in turn pave ways for profit maximisation in the long run.

III.2.3. Agency Theory

Managerial theory of the firm introduces human behaviour into the firm analysis; it was later evolved into the form of principal – agent analysis, whereby firm owner/shareholder is viewed as principal and firm managers as agent. One of the approaches in this analysis is the agency theory, which interestingly developed from the work of Jensen and Meckling (1976), a pioneer of neoclassical theory of firm. The contractual nature of the firm were perceived as a basis to analyse agency costs facing owner(s) as principal in contractual relationship with managers as agent. Herein, principals employ a group of agents (firm managers) to maximise the value of the firm. Since principals do not directly manage the firm, they will not have complete information in regard to firm performance whilst the agents possess more information in regard to firm's capabilities and performance. This leads to asymmetric information in principal – agent relationship that may induce moral hazard problem. Agency costs have to be spent by principals in monitoring agents' behaviour, which is the sum of monitoring expenditures by the principal, bonding expenditures incurred by agents, and the shortfall in the residual value for principal due to agency problem. It is basically the agent's deviation from principal's interest (Bebchuk & Fried, 2006).

Agency theory is on one side based on the bounded rationality of humans, i.e. the inability to foresee what will happen in the future when the work is delegated to the agent. On the other hand, humans are regarded as opportunists and only serve their own vested interests thus can take action unobservable by the principal, which affects the total amount of consumption or resources available not necessarily to the benefit of the principal (Eisenhardt, 1989). In light of this theory, the source of inefficiency in firm operation is the presence of moral hazard and conflict of interest between principal and agent. In order to manage this, monitoring and compensation are required to direct the agent to work toward the interest of the principal.

In the context of this research, agency theory perspective acts as a worldview theory explaining why field evidence and the result of quantitative analysis may not be the same with theory. It frames the measurement of MFI operation in terms of its social and financial efficiency. Indeed, the agency problem in microfinance has multiple natures (Mersland & Strøm, 2008). It explains the relationship between strategies laid out by MFIs' head office (the principal) with the execution of the field operatives (the agent). On the other hand, this theory also explains the relationship between MFI field operatives (the principal) with borrowers (the agent) regarding 'delegation' of microloan, i.e. loan purpose and its actual use. Regarding agency problem in head office – field operatives relationship, Morduch and Haley (2002), Navajas et al. (2000), and Morduch (2000) indicated that there may be deviation in what microfinance field operators actually did from the objectives from head office due to various factors such as perceived credit risks, asymmetric information and risk-averse motive of field operatives, especially if the incentive system for field operatives is based solely on financial yardsticks such as repayment rate, etc. This deviation further led to the failure of MFIs in achieving their objectives, i.e. led to MFIs' inefficiency.

III.2.4. X-Efficiency Theory

Observing evidence that firms in the market exhibit differences in performance, Leibenstein criticises neoclassical theory's assumption of profit maximisation and notion that only efficient firms exist in the market. Through a series of his seminal works that started with Leibenstein (1966), he introduced X-efficiency theory to provide alternative explanation as to why inefficient firms exist in the market. It postulates that in the absence of perfect competition market, as with the case with many real-world markets, firms may not be incentivised to continuously seek for more productive ways of operation to stay in business hence not producing at the lowest possible units costs as per assumption of neoclassical theory. In this situation, it is possible to stay in business even when organisational slack existed, i.e. non-optimal allocation of resources when firms employ more input resources in excess of that needed to secure a given output, hence inefficiency observed.

Most importantly, Leibenstein (1966) thus argues that firms may not all operate on the outer bound of the production possibility surface, i.e. production possibility frontier where efficient firms are located. Rather, most firms are producing either below or well within the production possibility frontier, i.e. the resources in these firms are not being used optimally as they should. He further introduces two possible sources of inefficiency. One source is called X-inefficiency, whereby a firm fails to fully utilize their resources given their allocation due to internal workings of the firm, e.g. due to lack of incentive to control costs, management incompetency, or work culture (Leibenstein, 1979; Mostafa, 2009). Another cause of inefficiency is due to a firm setting its price not at the level where it is equal to marginal cost; which is in neoclassical economics is referred to as allocative inefficiency. The latter occur in an imperfect market structure which impairs competitive output prices, e.g. monopoly.

Two movements are therefore suggested herein; a shift from lower production possibility surface to its outer boundary or production possibility frontier, which is a movement toward greater X-efficiency, and a movement along the production possibility frontier toward greater allocative efficiency. Leibenstein argues that inefficiency stems from X-inefficiency to be more significant than that from allocative efficiency. X-efficiency theory thus focuses on intra-firm behaviour analysis as opposed to the working price, with principal – agent problems lies thereof.

In the context of this study, X-efficiency serves as a backdrop from economic theory perspective in regard to the existence of different performance amongst MFIs observed; specifically, in relation to the observed inefficiency amongst MFIs. X-efficiency relates to the concept of technical efficiency covered in the next section, albeit with slight differences as in Leibenstein (1977), and a shift toward the outer bound of production possibility surface (or production possibility frontier) is an attempt to improve technical efficiency. Principal – agent conflict of interest between MFI head office and MFI field loan officer or between MFI as funder and borrowers as clients may lead to MFI inefficiency.

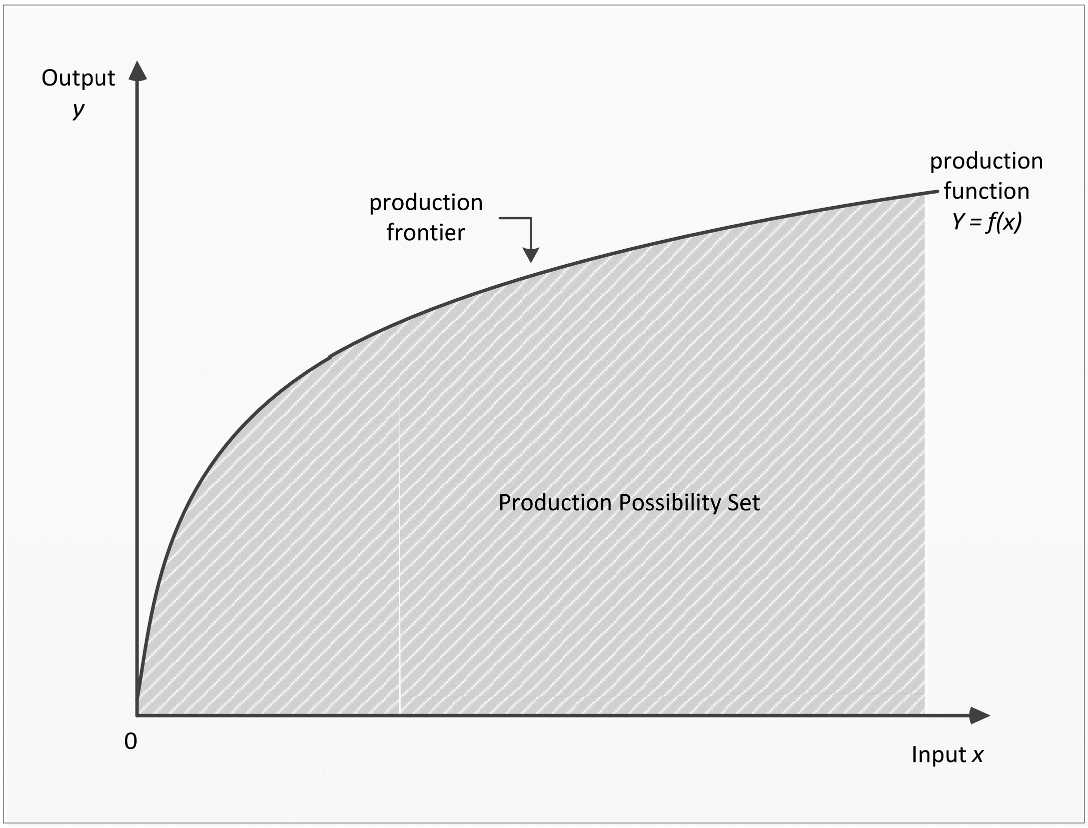
III.3. Production Theory, Efficiency and Productivity

III.3.1. Production and Technology

Production theory is economic theory that studies the economic process of converting set of inputs into outputs (Cobb & Douglas, 1928). Production process uses resources to create goods or services suitable for use in the market economy. Economic agent herein, as in other economic context, deals with continuous problems in decision-making with three basic features (Ray, 2004): (i) decision variables whose values have to be chosen; (ii) the existence of constraint(s) restricting the choice of values of the said variables; (iii) different criterion functions relating different values to outcomes of these decisions.

In production context, a firm is the decision-making agent; it faces decision variables of quantities of inputs and outputs to be used and to be produced, respectively. These choices are to be made subject to constraints such that the quantities of inputs used must be plausible to produce desired quantities of outputs. In other words, production process faces *technological constraint*, i.e. a limitation whereby only particular mixture of inputs is feasible to produce intended outputs (Varian, 2003), therefore firms have to adhere to the technologically feasible production process. The collection of all feasible mixtures of inputs and outputs in production process is termed as ***production possibility set*** or, in short, ***production set***. The boundary of this production set is a ***production possibility frontier*** or ***production frontier***, which is the outer bound of all production surfaces in production possibility sets. Production set and production possibility frontier of a simple economy of one input and one output is illustrated in Figure 3.1. The production possibility frontier can be generated from a mathematical formulation of production function. In a simple economy of one input and one output, the production frontier represents the maximum possible output that can be produced from available input.

Figure 3.1: Production Function and Production Frontier (Single Input- Single Output)



Source: Varian (2003), modified and redrawn by author

A criterion of choice will then serves as reference to which outputs produced from quantities of inputs chosen is evaluated. For example, for a state-owned public utility firm such as state-owned water companies, the criterion of choice will be the extent to which its output can be distributed to all parts of the country, as opposed to profit. Production process in production theory itself is not limited to manufacturing of physical goods; it also encompasses production of services so it is broadly defined as any transformation process of inputs into outputs (Thanassoulis, 2001). Therefore, a suitable criterion of choice will be very important factor to evaluate the performance of a transformation process in respective context.

III.3.2. Pareto Optimality

Since allocation of resources plays an important role in an economy, it is important to review how an economic institution such as a firm allocates its resources; especially in making comparison between the outcomes of different firms. Vilfredo Pareto (1848 – 1923), a nineteenth-century Italian economist and sociologist, introduced a beneficial concept for this purpose that is now termed as *Pareto optimality*. In economics context, it is generally defined as a state of resources allocation in which alternative *feasible* resources allocation that can improve one party's condition without making at least other party worse off does not exist (Stiglitz, 1981). In a given state of resources allocation, if there is still way to improve the allocation so that one party can be made better off without deteriorating the condition of other party, then this current state of allocation is considered as *Pareto-inefficient*; and the effort to improve this allocation is termed as *Pareto improvement*. Consequently, a state of allocation whereby no Pareto improvement can be made is a *Pareto-efficient* allocation. It can be deduced from these that an allocation is *Pareto superior* to another allocation if a Pareto improvement from the latter to the former is possible.

Pareto optimality or *Pareto efficiency* thus evaluates resource allocation not in isolation, but based on its comparative values against other possible allocations. In a production context, Pareto efficiency compares an allocation of inputs to produce outputs to other possible inputs – outputs allocation. As per Thanassoulis (2001), in a production transformation with output-maximisation objective (output-orientation), a firm is considered to be *Pareto-efficient* if it is not possible to increase further the level of any of its outputs without reducing at minimum one of its other output levels and/or without increasing the level of at least one of its inputs. Conversely, in an input-minimising transformation (input-orientation), a firm is said to be *Pareto-efficient* if it is not possible to reduce further the level of any of its inputs without increasing the level of at least one of its other inputs and/or decreasing the level of any of its outputs. These concepts are thus very useful in the context of performance evaluation, as will be conducted in this research.

III.3.3. Efficiency: the Concept

Efficiency deals with how organization arranges and uses its resources to produce the optimal amount of output. Thanassoulis (2001) offers its working definition as the optimal utilisation of available inputs in transformation process to produce outputs.

As discussed in Section III.3.1 above, production is value creation through transformation process of resources as inputs into desirable outputs. With this understanding any unfulfilled objectives or any unutilised resources is a waste; since output is desirable outcome, attaining less output that it potentially capable of is a waste. On the other hand, underutilised inputs are also waste since they have opportunity cost; they are valuable resources that can be utilised to produce alternative goods. Therefore, an efficient resource allocation has twin objectives of (i) producing a given level of outputs with as minimum inputs as possible, and simultaneously (ii) producing as maximum outputs as possible by utilising available quantities of inputs (Ray, 2004).

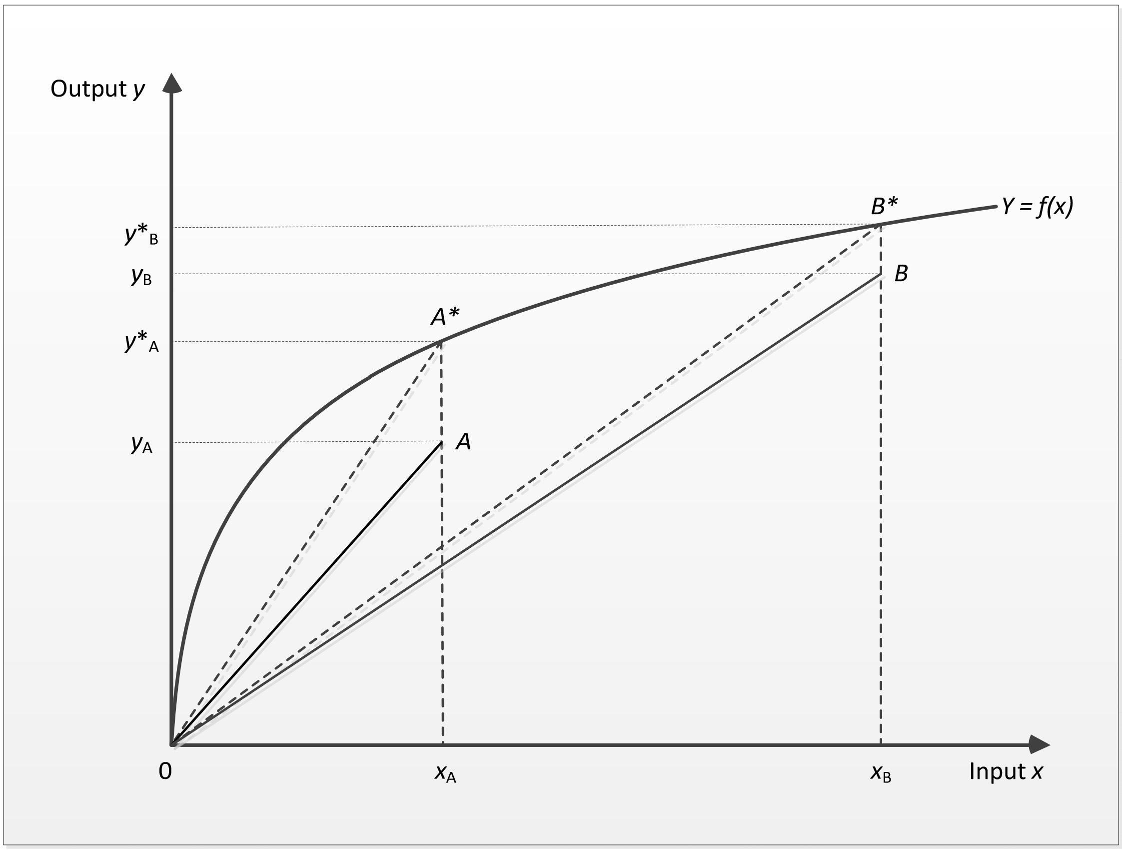
The above efficiency definition (especially the use of the word "optimal") and twin objective of resource allocation (in the definition of what considered unspent resources or potential outputs that can be gained) imply that performance of a firm as a decision-making economic agent has to be measured against specific benchmark, otherwise it will be difficult to judge whether a waste exists in a transformation process. Ray (2004) stated that a finite maximum value calculated from a choice criterion function can be stated as benchmark; if there is an absence of computable criterion function as in the case of service or not-for-profit industries then the benchmark can be derived from empirical observation. Therefore, the definition of efficiency can be specified into the concept of ***relative efficiency***, which is the extent to which the actual observable use of resources to produce outputs of a given quality matches the optimal use of resources to produce outputs at given quality (Farrell, 1957).

Efficiency measurement thus offers an objective and measurable basis to evaluate performance of economic agent. The closer the performance of a decision-making firm to the stated benchmark means the higher its efficiency hence higher standard in terms of management by objectives. The possibility to include different inputs and outputs into the measurement gives it an advantage over partial measurement such as traditional financial indicators. It makes possible the observation of how various environmental variables affect firm performance by observing how they affect firm's efficiency. If identical input levels utilised by a firm and its benchmark produced two different level of outputs, or if identical level of outputs of a firm and its benchmark were produced from two different input levels, then it can be deduced that this discrepancy is caused by other factors that are not included in the input – output specification (Ray, 2004). Indeed, every input-output combination is essentially efficient, yet excluded variables cause the divergence from efficient points hence create inefficiency (Stigler, 1976); inefficiency is thus attributed to human factors such as aptitude, inability and exertion

As previously mentioned, the benchmark to which efficiency is measured at the practical level is determined by the technology constraint of the firm, i.e. outputs can only be maximised or inputs can only be minimised using a feasible inputs – outputs combination. Therefore, the evaluation of firm performance against stated benchmark in regard to these two objectives yields a magnitude of ***technical efficiency***. Technical efficiency (TE) is therefore the extent to which actual utilisation of inputs to produce outputs in a transformation process corresponds to the Pareto-optimal use of inputs to produce outputs in the face of a given technology.

As an example, consider two firms A and B in a simple transformation process with one input and one output in Figure 3.2. In this situation technology is described by the production function $Y = f(x)$ which creates a production possibility frontier OA*B*. Firm A and firm B currently uses input x_A and x_B to produce output y_A and y_B, respectively. If the objective of these firms is to maximise output from their given available input, this is coined as a strategy of ***output-orientation***. Firm A herein can be projected to the production frontier by expanding its output all the way until it reach point A* that is located on the production frontier, which has an output of $y_A^* = f(x_A)$. This output is the maximum output that can be produced using input x_A. Likewise, firm B can be projected to point B* on the frontier with output $y_B^* = f(x_B)$, which represents a maximum output from inputs x_B.

Figure 3.2: Output-oriented Technical Efficiency (Single Input – Single Output)



Source: Ray (2004), redrawn and modified by author

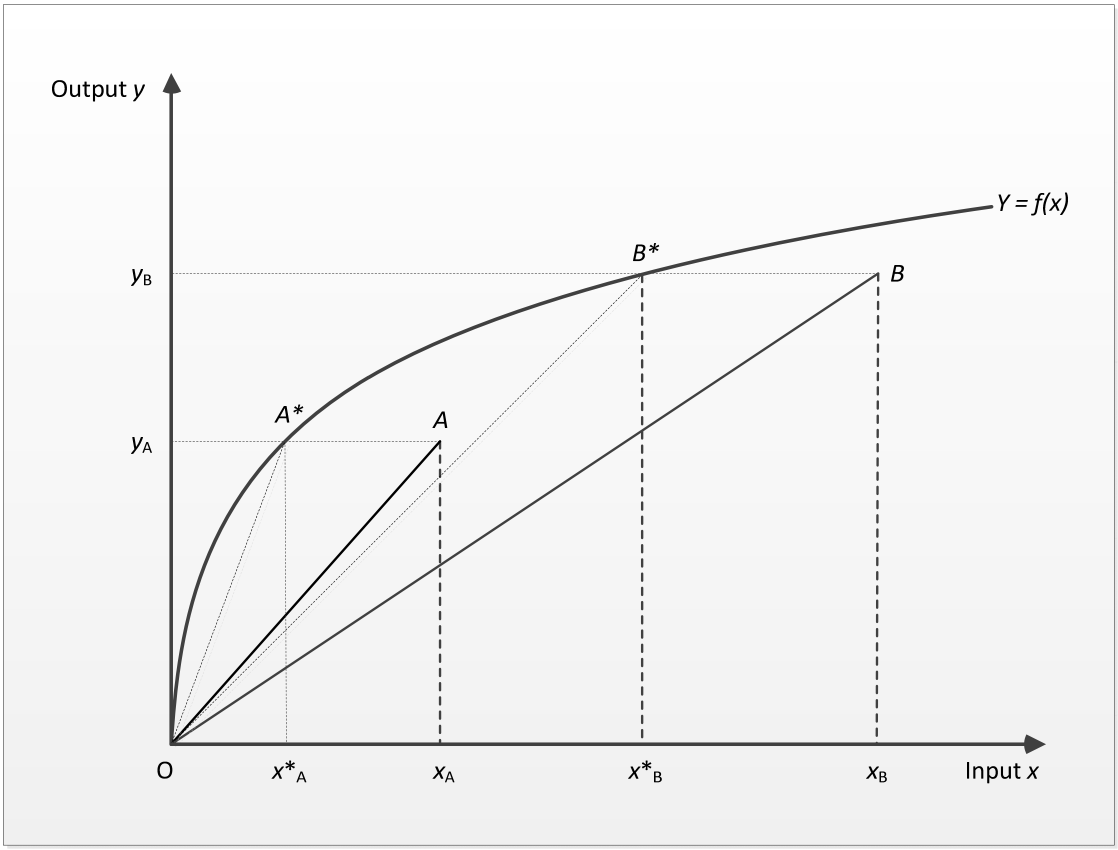
Output-oriented technical efficiency of firm A in Figure 2.3 can be calculated by comparing its actual output y_A with the feasible maximum output of y_A^* at A*. Thus, the output-oriented technical efficiency of Firm A can be calculated as:

$$TE_O^A = \frac{\text{slope } OA}{\text{slope } OA^*} = \frac{\left(\frac{y_A}{x_A}\right)}{\left(\frac{y_A^*}{x_A}\right)} = \frac{y_A}{y_A^*} = \frac{x_A A}{x_A A^*} \leq 1 \tag{3.1}$$

Output-oriented TE of Firm A can be calculated as slope of *OA* relative to slope of *OA**. Similarly, the input-oriented technical efficiency for firm B can be calculated as:

$$TE_O^B = \frac{\text{slope } OB}{\text{slope } OB^*} \frac{\left(\frac{y_B}{x_B}\right)}{\left(\frac{y_B^*}{x_B}\right)} = \frac{y_B}{y_B^*} = \frac{x_B B}{x_B B^*} \le 1 \tag{3.2}$$

Figure 3.3: Input-oriented Technical Efficiency (Single Input - Single Output)



Source: Ray (2004), redrawn and modified by author

On the contrary, if both firm A and B prefer an input-saving strategy by minimising quantity of input needed to produce a given output of y_A and y_B, respectively, then this strategy is termed as ***input-orientation*** strategy. From Figure 3.3 it can be observed that inputs for A and B can be reduced proportionately whilst keeping outputs constant by projecting point A and B horizontally to the production possibility frontier until they reached point A* and B*, respectively. At point A*, the input needed to produce output y_A is only x_A^* that is the minimum feasible input from the production function $Y = f(x)$.

Similarly, at point B* at the production frontier reduced quantity input x_B^* can be used to produce y_B . The input-oriented technical efficiency of A and B can then be written as:

$$TE_I^A = \frac{\text{slope } OA}{\text{slope } OA^*} = \frac{\left(\dfrac{y_A}{x_A}\right)}{\left(\dfrac{y_A}{x_A^*}\right)} = \frac{x_A^*}{x_A} \leq 1 \tag{3.3}$$

and

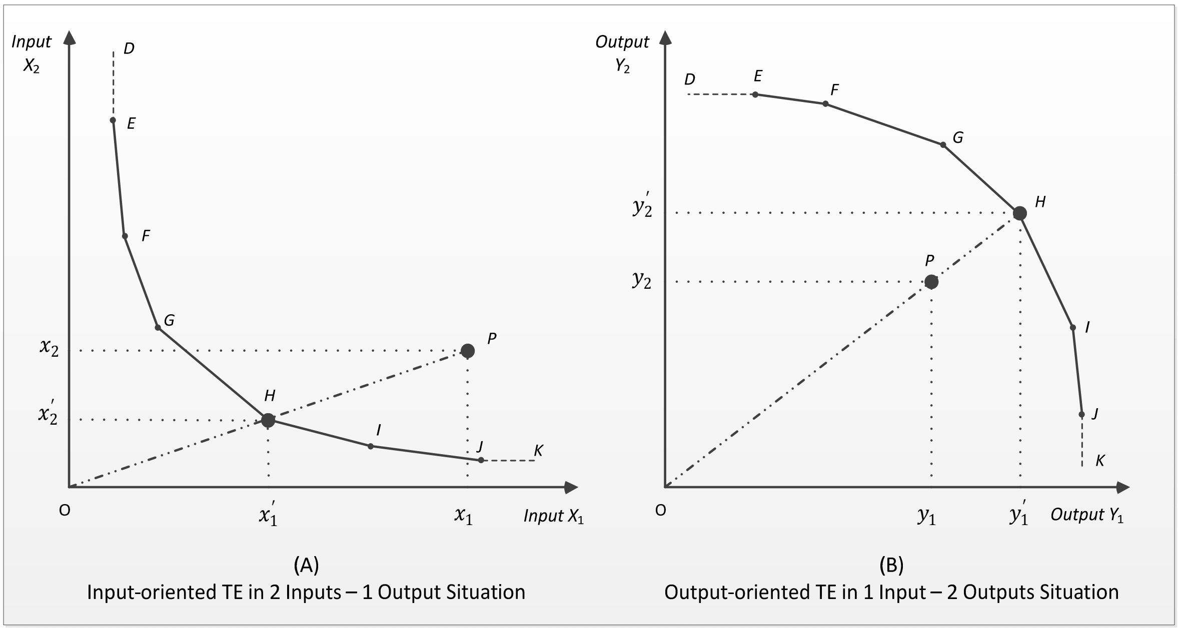
$$TE_I^B = \frac{\text{slope } OB}{\text{slope } OB^*} = \frac{\left(\dfrac{y_B}{x_B}\right)}{\left(\dfrac{y_B}{x_B^*}\right)} = \frac{x_B^*}{x_B} \leq 1 \tag{3.4}$$

In these single-input single-output examples in Figure 3.2 and 3.3, the production possibility frontier OA*B* is constructed from a simple production function of $Y = f(x)$, thus performance of A and B are compared to a hypothetical firm A* and B* respectively that are located on the production frontier. In the case where production function is unknown or difficult to predict, as in the case of not-for-profit MFIs, thus it has to be created from empirical observation. Chapter IV will explore alternative non-parametric method such as Data Envelopment Analysis that can create a piecewise linear production possibility frontier from the data without *a priori* production function estimation.

In more realistic settings of transformation processes using more than one input and/or more than one output environment, Figure 3.4 illustrates how input-oriented technical efficiency in two inputs – one output situation and output-oriented technical efficiency in one input – two outputs situation are calculated. In the two inputs – one input situation on the left of Figure 3.4, benchmark for input-oriented technical efficiency of Firm P is observed by equiproportional reduction of inputs until it reach the production possibility frontier at H. The benchmark firm H thus has the same input mixture with Firm P, producing the same given output level but with minimum quantity of inputs. The input-oriented technical efficiency of P will thus be calculated as $^{OH}/_{OP}$.

Equally, benchmark for output-oriented technical efficiency for Firm P in one input – two outputs situation on the right of Figure 3.4 is observed by projecting the output mix equiproportionately until it reach the production possibility frontier at H, which using the same output mixture with P but producing maximum quantity of outputs with the same level of input. The output-oriented technical efficiency of P herein is calculated as $^{OP}/_{OH}$.

Figure 3.4: TE in Two Inputs – One Output and One Input – Two Outputs Situations



Source: (Thanassoulis, 2001), redrawn and modified by author

III.3.4. Efficiency and Productivity

In the simple example of single input – single output transformation above, efficiency is calculated in relative terms by directly comparing input-output ratio of a firm (signifying performance of a firm at time *t*) with ideal input-output ratio of its benchmark on the production possibility frontier (representing performance of its benchmark at time *t*). In a real-world scenario however, there is usually more than one input and/or more than one output so these inputs and outputs have to be aggregated first before comparison. Unfortunately, in everyday uses in many fields, such as in business, finance, politics and even official statistics, efficiency measures are still commonly regarded as being ratios of selected input and selected output, e.g. return on assets, return on equity, and gross value added per man-hour worked, calculated in one time *t*. On the other hand, the concept of productivity in everyday uses is also understood in the same fashion; it is commonly calculated in these practical fields as ratio of selected single output over single input in a specified time *t*. As a result, the terms efficiency and productivity are often overlapping in usage; they are considered as equivalent thus used interchangeably.

Nevertheless, this is theoretically incorrect, since efficiency and productivity are related but are essentially different concepts. Productivity depicts a *descriptive* measure of firm performance, i.e. performance of a firm per se, whilst efficiency reveals a *normative* measure of firm performance, i.e. performance of a firm compared to a benchmark. Ray (2004) exhaustively discusses this conceptual difference, suggesting that a firm's technical efficiency is its *productivity index relative to a benchmark* whereby maximum output is produced using the same input or equivalent output is produced using minimum input. Thus, understanding productivity within this definition does not require any knowledge about technology, whilst measuring efficiency requires knowledge of reference technology in the form of production possibility frontier. This frontier is derived from parametric production function or constructed empirically by way of non-parametric methodology as will be discussed in chapter IV.

Moreover, the concept of productivity calculated from ratio of single output over single input as shown above is essentially an ***average productivity*** concept. Once the scenario is relaxed to a multiple input – multiple output situation, even in simple two inputs – one output or one input – two outputs as depicted in Figure 3.4 above, average productivity cannot be calculated with this ratio since average productivity relative to one input is contingent to other input as well (Ray, 2004). Since this is essentially a partial productivity analysis, thus measuring productivity of a firm solely on the basis of one input without considering other inputs, such as the common application in business, politics and official statistics, are improper, let alone using this measure for productivity growth analysis. A more comprehensive concept of total factor productivity is therefore needed, which will be discussed in Section III.4.3 below.

III.3.5. Returns to Scale

Returns to scale is a concept in economics that is associated with the variability of outputs should there be a proportional change in inputs, implied by production function or technology of the firm. In microeconomics, the short run period refers not to a specific calendar time but to a period of time wherein at least one input is fixed whilst other inputs can be altered. On the other hand, the long run refers to period of time in which all inputs can be considered as variable. Consequently, returns to scale concept concerns with the rate of increase in outputs if all inputs be increased by the same proportion in the long run. It is thus purely technologically influenced rather than affected by managerial decision or environmental factors. There are two major types of return to scale that can further be broken down into three types as follow:

1) *Constant returns to scale (CRS)*

CRS refers to the production situation whereby output increases exactly by the same proportion with all inputs increase proportionally. In two inputs – one output production function $f(x_1, x_2)$ if all inputs are increased by k then$f(kx_1, kx_2) = kf(x_1, x_2)$.

2) *Variable returns to scale (VRS)*

VRS, on the other hand, refers to the production situation when output increases in a different proportion than the rate of proportional change of all inputs. Besides its segment that show CRS technology, VRS can further be divided into two different return to scale, which are usually form segments of VRS frontier, as follow:

a) *Increasing returns to scale (IRS)*

IRS condition prevails when output produced increases by more than proportional change in all inputs, as an example if inputs increase by 50% then output increases by more than 50%. In $f(x_1, x_2)$ if k proportional increases of all inputs resulted in $f(kx_1, kx_2) > kf(x_1, x_2)$.

b) *Decreasing returns to scale (DRS)*

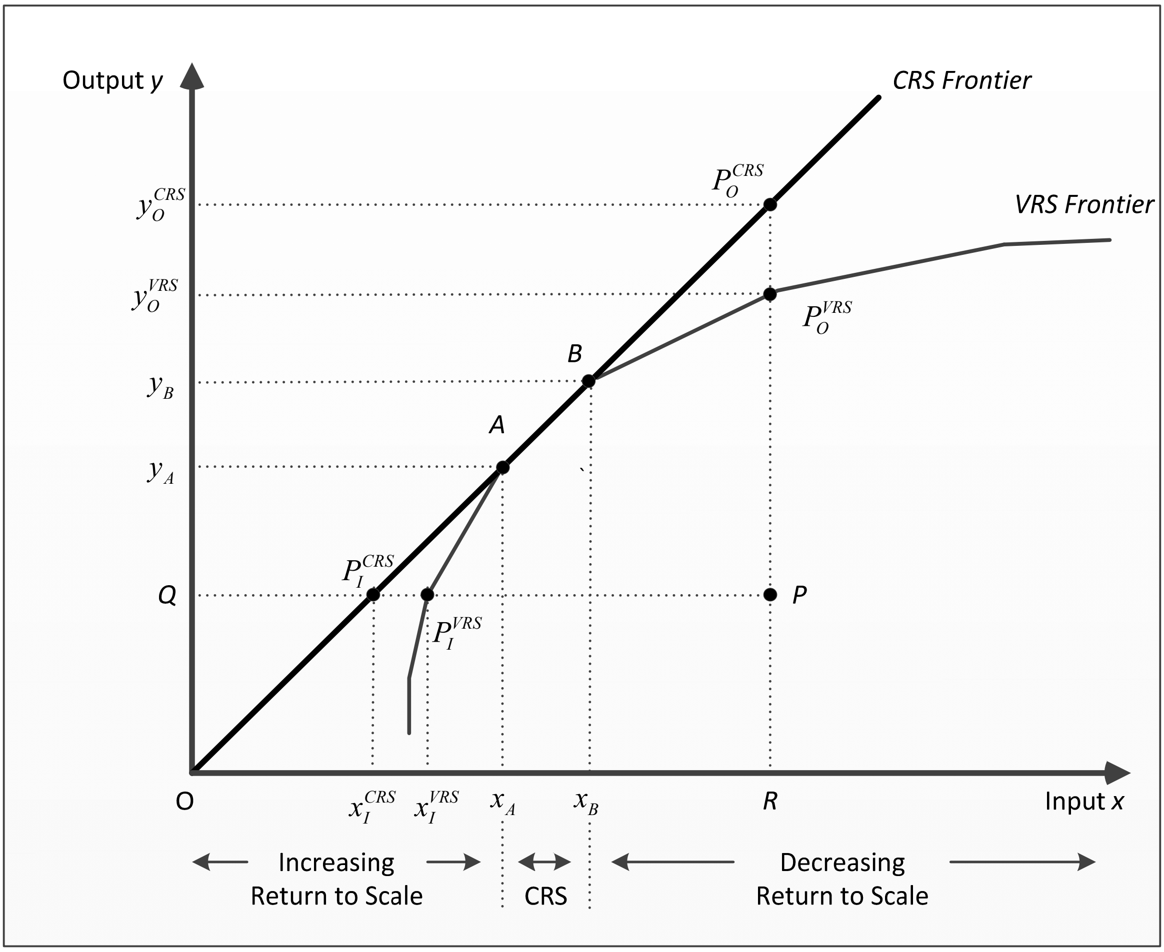
Consequently, DRS condition exists when the proportional increase in inputs resulted in smaller proportional increase in output. The proportional increase of k in all inputs for $f(x_1, x_2)$ will yield in $f(kx_1, kx_2) < kf(x_1, x_2)$

From the above definitions, these different types of returns to scale are related to the long run relationship of average cost and output produced by firm. In IRS condition, since the proportional increases in all inputs resulted in more than proportional increase in output, the long-run average cost would fall, indicating a condition of ***economies of scale***. On the contrary, in DRS the average cost would increases and a condition of ***diseconomies of scale*** exists.

Therefore, these different types of returns of scale can be exhibited at the different stages of a firm long run production function of a firm. In relation to the average cost implication, then it is noted in literatures, e.g. Coelli et al. (2005), that a firm in an early stage of production with relatively low output levels will be under *locally* IRS condition since increasing inputs proportionally at this stage increases outputs more than proportionally. Whilst, a firm with relatively high output levels at the mature stage of production will experience locally DRS condition and locally CRS condition prevails at output levels between those ranges.

This is illustrated in Figure 3.5 for single input – output situation. If a firm is under CRS condition, the production frontier would be a straight line from the origin, indicating that a proportional increase in input yield the same proportional increase in output. In Figure 3.5, the local CRS condition is illustrated as a 45° linear ray from the origin, which is a sufficient but not necessary condition for CRS. Whereas under VRS condition, the simple production frontier follows the s-shape ray from the simple production function $y = f(x)$. From the beginning of production until it reaches point A with output level y_A, a firm is in locally IRS condition, since any proportional increase in inputs resulted in larger than proportional increase in output hence higher average productivity; whilst from output level y_B corresponding to point B onward, any additional input would not result in higher average productivity hence locally DRS condition. Stage of production along segment AB coincides with CRS production frontier and indeed representing locally CRS condition.

Figure 3.5: Returns to Scale and Production Frontier



Source: Thanassoulis (2001) and Ray (2004), redrawn and modified by author

Since under CRS any proportional increase in all inputs will result in identical proportional increase in outputs, hence the average productivity along local CRS segment of production will be constant. This means that along local CRS segment such as segment *AB* in Figure 3.5 above, average productivity will not be influenced by scale of production. Producing output level y_A until y_B will not change average productivity. Thanassoulis (2001) thus argues that in real life context the CRS assumption may not always be realistic since production scale is likely to affect average productivity, i.e. it is possible to achieve higher average productivity due to larger scale of production and it is possible to gain lower average productivity if the production scale exceeds optimum scale of production, i.e. due to law of diminishing marginal returns. Suppose that firms D and E are homogeneous firms that use identical inputs to produce identical outputs and assumed to be under CRS condition; if firm D uses half inputs quantity of that used in firm E, it still cannot be certainly concluded that the outputs of firm D will be half that of firm E.

Consequently, in the context of microfinance analysis in this study, VRS assumption will be used as MFIs in the dataset are of different sizes and operational scales, which in many cases to different extremes, and it cannot be realistically suggested that this size differences would not have any effect to their average productivity. This is in parallel with Thanassoulis (2001) who argued that VRS assumption is one that can be realistically made in respect to returns to scale. This point will be discussed in later section in this chapter.

III.3.6. Efficiency Orientation and Returns to Scale

In regard to technical efficiency under VRS and CRS assumption, one can observe from Figure 3.5 several important features. Firstly, input-oriented and output-oriented technical efficiency under VRS assumption will normally yield different measures since they depend on the shape of the production frontier created from production function or technology used by the firm. A firm at point P is using input R to produce output Q. Under VRS conditions, its output-maximising technical efficiency is calculated by projecting its position upward to the VRS production frontier and by comparing its output to its benchmark on the VRS production frontier therein, i.e. point P_O^{VRS} which uses the same quantity of input. Its output-oriented technical efficiency is therefore Q/y_O^{VRS}. Conversely, its input-minimising technical efficiency is calculated by projecting its position horizontally to the VRS production frontier to point P_I^{VRS} which produces the same quantity of output as its benchmark. Thus, its input-oriented technical efficiency is calculated as x_I^{VRS}/R. Due to the properties of the VRS production frontier, these two measures will be different.

Secondly, under CRS assumption the production frontier in a single input – single output technology is a straight line to the origin, thus the distance of point P to its projection point P_O^{CRS} on CRS frontier (or its CRS output-orientated technical efficiency) i.e. Q/y_O^{CRS}, will be equal to its distance to its projection point P_I^{CRS} on CRS frontier (its CRS input-orientated technical efficiency) that is x_I^{CRS}/R.

It can be seen mathematically from Ray (2004) as follow: in multiple inputs – multiple outputs situation, if $(\hat{x}_P, \hat{y}_P)$ be the pair of aggregate inputs – aggregate outputs of a firm P such as:

$$
\begin{aligned}
&\hat{x} = \sum_{i=1}^{m} v_i x_i \qquad i = 1,2,\ldots,m \\
&\hat{y} = \sum_{r=1}^{s} u_r y_r \qquad r = 1,2,\ldots,s \\
&\sum_{i=1}^{m} v_i = 1; \qquad \sum_{r=1}^{s} u_r = 1 \\
&u_r, v_i \geq 0
\end{aligned}
\tag{3.5}
$$

whereby $\hat{x}_P$ is the aggregate inputs used by firm P, $\hat{y}_P$ is the aggregate outputs produced by firm P, v_i and u_r are weights assigned to *i*th input and *r*th output used in production, respectively. Under CRS condition, if inputs are increased by k then $(k\hat{x}_P, k\hat{y}_P)$ is also a feasible pair for any $k \geq 0$.

If it is assumed for output-oriented technical efficiency of firm P under CRS, the maximum producible outputs is $\hat{y}_P^*$ and ϕ^* is the maximum value of ϕ to ensure equiproportional increase of all outputs in order for $(\hat{x}_P, \phi\hat{y}_P)$ to be within the production possibility set T^{CRS}, then the output-oriented technical efficiency of firm P is:

$$
TE_O^{CRS} = \frac{\hat{y}_P}{\hat{y}_P^*} = \frac{\hat{y}_P}{\phi^* \hat{y}_P} = \frac{1}{\phi^*} \tag{3.6}
$$

On the other hand, let θ^* be value that ensures the equiproportional reduction of all inputs to the minimum level of inputs to maintain production of a given output $\hat{y}_P$ for input-oriented TE. Then aggregate input – output in input-oriented TE in CRS (TE_I^{CRS}) is:

$$(\theta^* \hat{x}_P, \hat{y}_P) \in T^{CRS} \tag{3.7}$$

Whereby TE_I^{CRS} itself can be calculated as:

$$TE_I^{CRS} = \frac{\hat{x}_P^*}{\hat{x}_P} = \frac{\theta^* \hat{x}_P}{\hat{x}_P} = \theta^* \tag{3.8}$$

If aggregate input – output combination for TE_O^{CRS} is $(\hat{x}_P, \phi^* \hat{y}_P) \in T^{CRS}$; then k changes in both inputs and outputs changes TE_O^{CRS} specification to:

$$(k\hat{x}_P, k\phi^* \hat{y}_P) \in T^{CRS} \tag{3.9}$$

If k is set to be $k = \dfrac{1}{\phi^*}$ from equation (3.6) then for TE_O^{CRS} in equation (3.9) the combination becomes:

$$\left(\frac{1}{\phi^*}\hat{x}_P, \hat{y}_P\right) \in T^{CRS} \tag{3.10}$$

Therefore by equalising equation (3.7) with equation (3.10), it can be concluded that:

$$TE_I^{CRS} = \theta^* = \frac{1}{\phi^*} = TE_O^{CRS} \tag{3.11}$$

Therefore, under CRS assumption, input-orientation technical efficiency will be identical with output-orientation technical efficiency. The vital part for this notion is the fact that under CRS if inputs are increased by k then $(k\hat{x}_P, k\hat{y}_P)$.

Thirdly, it can be seen graphically from the Figure 3.5 that the distance between Firm P to either its output- and input-oriented benchmarks on the IRS and DRS production frontier are closer than that on CRS production frontier. This means that VRS technical efficiencies of P are the same or greater than its CRS technical efficiencies. This is due to the fact that under CRS condition, since $(k\hat{x}_P, k\hat{y}_P)$ holds whenever there is a k

proportional increase in inputs, average productivity stays constant along the frontier hence production scale is not a concern. On the contrary, under VRS assumption, this condition only holds on local CRS segment yet it does not hold under local IRS and local DRS conditions since the effect of k increase on inputs will be different depending on the scale of the firms.

Therefore, a firm under CRS condition is assessed against all firms in production possibility set whilst under VRS condition a firm only to be assessed against similarly-sized firms in the production possibility set (Thanassoulis, 2001) thus the efficiency score will be higher due to smaller number of firms in production sets as comparison. This point will be discussed further in the next section below.

III.3.7. Scale Efficiency and Pure Technical Efficiency

In reference to the discussion above, CRS technology is *scale-efficient*, i.e. there is a constant average productivity when a firm increasing its inputs in any operational scale (T. J. Coelli et al., 2005). Whilst under VRS assumption, increasing inputs by the same proportion under local IRS will increase average productivity, whilst under local DRS it will reduce average productivity. Thus, a firm that is not operating under local CRS condition will therefore improve its average productivity if it changes its scale size to a point where local CRS condition is present. Therefore, the optimal scale for a firm to operate is that under global CRS technology or where local CRS holds in VRS technology, which is termed in literature as ***most productive scale size*** (MPSS) or ***technically optimal productive scale*** (TOPS), e.g. in Thanassoulis (2001) and Coelli et al. (2005), since altering the production scale under this condition would not make a firm more productive. MPSS or TOPS can be written as $MPSS\ /\ TOPS = \max\left\{\frac{y}{x} \mid (x, y) \in T\right\}$. As scale of operation is usually cannot be improved in the short run, one can view technical efficiency under VRS condition as firm's technical efficiency in the short run whilst technical efficiency under CRS condition as its technical efficiency in the long run (T. J. Coelli et al., 2005).

The distance between the firm performance in its most productive scale and its performance under VRS technology can be regarded as ***scale efficiency***. Scale efficiency calculates the impact of scale size by measuring an organisation's technical efficiency at its current production scale relative to its technical efficiency had it been operating at its most productive scale size, thus it can measure increase of productivity I (T. J. Coelli et al., 2005; Thanassoulis, 2001). In a one input – one output example in Figure 3.5, input-oriented scale efficiency of Firm P can be observed as the distance of its VRS technical efficiency point of P_I^{VRS} to its technical efficiency in its MPSS, P_I^{CRS}. It thus can be calculated in terms of their slopes as follow:

$$SE_I = \frac{QP_I^{CRS}}{QP_I^{VRS}} = \frac{\left(\dfrac{OP_I^{CRS}}{OP}\right)}{\left(\dfrac{OP_I^{VRS}}{OP}\right)} = \frac{OP_I^{CRS}}{OP_I^{VRS}} = \frac{TE_I^{CRS}}{TE_I^{VRS}} \tag{3.12}$$

Whilst for the output-oriented scale efficiency of Firm P, the distance of its VRS technical efficiency point of P_I^{VRS} to its technical efficiency in its MPSS, P_I^{CRS}, can be calculated in regard to their slopes as follow:

$$SE_O = \frac{RP_O^{VRS}}{RP_O^{CRS}} = \frac{\left(\dfrac{OP}{OP_O^{VRS}}\right)}{\left(\dfrac{OP}{OP_O^{CRS}}\right)} = \frac{OP_O^{CRS}}{OP_O^{VRS}} = \frac{TE_O^{CRS}}{TE_O^{VRS}} \tag{3.13}$$

Therefore from equation (3.11) and (3.12) it can be deduced that scale efficiency can generally be written such as the following:

$$\begin{aligned} SE_I &= \frac{TE_I^{CRS}}{TE_I^{VRS}} \\ SE_O &= \frac{TE_O^{CRS}}{TE_O^{VRS}} \end{aligned} \tag{3.14}$$

Scale efficiency represents a higher output a firm could produce (in an output-oriented performance measurement) or a higher expenditure saving a firm could make by using less input (in an input-oriented performance measurement), had it been operating in its MPSS; even if it had been reaching full efficiency in its current production scale. Consequently, a firm's technical efficiency under local DRS or local IRS assumption in VRS technology will be lower than its technical efficiency in its MPSS, i.e. under CRS technology, suggesting that its CRS technology benchmark is a Pareto-efficient benchmark which is more productive and that scale size indeed affect a firm's productivity. Equation (3.13) suggests that the larger the difference between a firm's CRS and VRS technical efficiency, the smaller its scale efficiency and the more severe its scale size impact to its productivity (Thanassoulis, 2001).

On the other hand, since equation (3.13) can be rewritten as $TE^{CRS} = TE^{VRS} x\ SE$, then the VRS technical efficiency of a firm is termed as its ***pure technical efficiency***, since it resembles its performance relative to its benchmark in its current return to scale assumption before taking account the impact of a scale size from its distance to its MPSS.

In the context of microfinance study, parallel to the point made at the end of Section III.3.6 above, MFIs are not always equal in size thus the effect of scale efficiency is deemed to be significant in its operation. Therefore, the notion that all firms are operating at their MPSS is not realistic to be applied in microfinance setting.

III.3.8. Technical, Allocative, and Cost Efficiency

In his seminal work that defined modern efficiency measurement, Farrell (1957) suggested that firm efficiency consists of components such as technical efficiency, which have been introduced herein from section III.3.1 until now, and ***allocative efficiency***; that combined into ***overall cost*** or ***economic efficiency***. The conceptual differences between these efficiencies are presented in the following:

1. Technical Efficiency

Introduced by Farrell (1957), technical efficiency deals with utilisation of inputs to produce outputs in a transformation process, i.e. demonstrating maximum outputs that can be produced under given quantity of inputs or reduction of inputs that can be attain whilst preserving a given quantity of outputs, relative to the benchmark(s) of Pareto-optimal inputs and outputs combination in a given technology. Based on the difference in measurement methods which will be described in the Chapter IV, the benchmark(s) could be in the form of hypothetical 'best' inputs – outputs combination in a given technology calculated using parametric method, or best practice firms in its production possibility sets with similar characteristics (Emrouznejad & Anouze, 2010; Thanassoulis, 2001). Technical efficiency rating is expressed as a percentage of its benchmark, which is considered to be fully technical efficient. However, technical efficiency does not take into account output prices/values and input costs; rather, it is influenced by managerial practice and operational scale (Bhat et al., 2001; Thanassoulis, 2001).

2. Allocative Efficiency

In a condition whereby input costs and output prices are known, allocative efficiency, which in Farrell (1957) was termed as *price efficiency*, in input orientation model represents the gap or the difference of input mix utilised by a firm from the optimal mix it could have used had it produced the output with the minimum input costs; whilst in output orientation model, it represents the difference of revenue of an organisation from the output mix it produced and revenue that it could have obtained had it produced optimum output mix that can maximise its revenue (Coelli et al., 2005; Thanassoulis, 2001). It portrays the difference of the technically-efficient point of a firm at the frontier to its corresponding point at *isocost* line (for input orientation model) and at *iso-revenue* line (for output orientation model).

3. Overall Cost Efficiency or Economic Efficiency

Overall cost efficiency or economic efficiency is a combination of technical and allocative efficiency, where a firm is only said to reach overall cost efficiency or economic efficiency if it is both technically and allocatively efficient (Bhat et al., 2001; Coelli et al., 2005; Thanassoulis, 2001).

A graphical illustration of these three efficiencies in two inputs – one output situation under input orientation strategy is described in Figure 3.6. A Firm P is using two inputs, x_1 and x_2 , in producing one input, *y*. At its current position, Firm P is facing an input cost function of $c_1x_1 + c_2x_2 = k_0$. Its input-oriented technical efficiency (TE_P) can be projected equiproportionally to its benchmark at point H in the production frontier isoquant DEFGHIJK, and can be calculated as

$$TE_P = \frac{OH}{OP} \quad (3.15)$$

However, even though point H is P's technically-efficient point, it is not necessarily a production point that ensures the lowest costs from inputs savings. If the lowest input-price ratio is known, which is an isocost C*C* that represent a cost function of $c_1^* x_1^* + c_2^* x_2^* = k_1$, then the point in the production frontier DEFGHIJK that gives the lowest possible input costs is actually point G, where the isocost C*C* is tangent to the production frontier DEFGHIJK. Therefore, the allocative efficiency (AE_P) as the difference of the technically-efficient point H to the technically- and allocatively-efficient isocost C*C* can be calculated through its equiproportional projection to point Q at C*C*, that can be written as:

$$AE_P = \frac{OQ}{OH} \tag{3.16}$$

Allocative efficiency AE_P calculated herein representing the cost savings in inputs uses had Firm P been operating at the technically- and allocatively-efficient point G, instead of only at technically-efficient but allocatively-inefficient point H.

The overall cost efficiency (CE_P) of Firm P can be calculated from the distance of its current production point P to its projection to technically- and allocatively-efficient point at point Q on the isocost C*C* as follow:

$$CE_P = \frac{OQ}{OP} \tag{3.17}$$

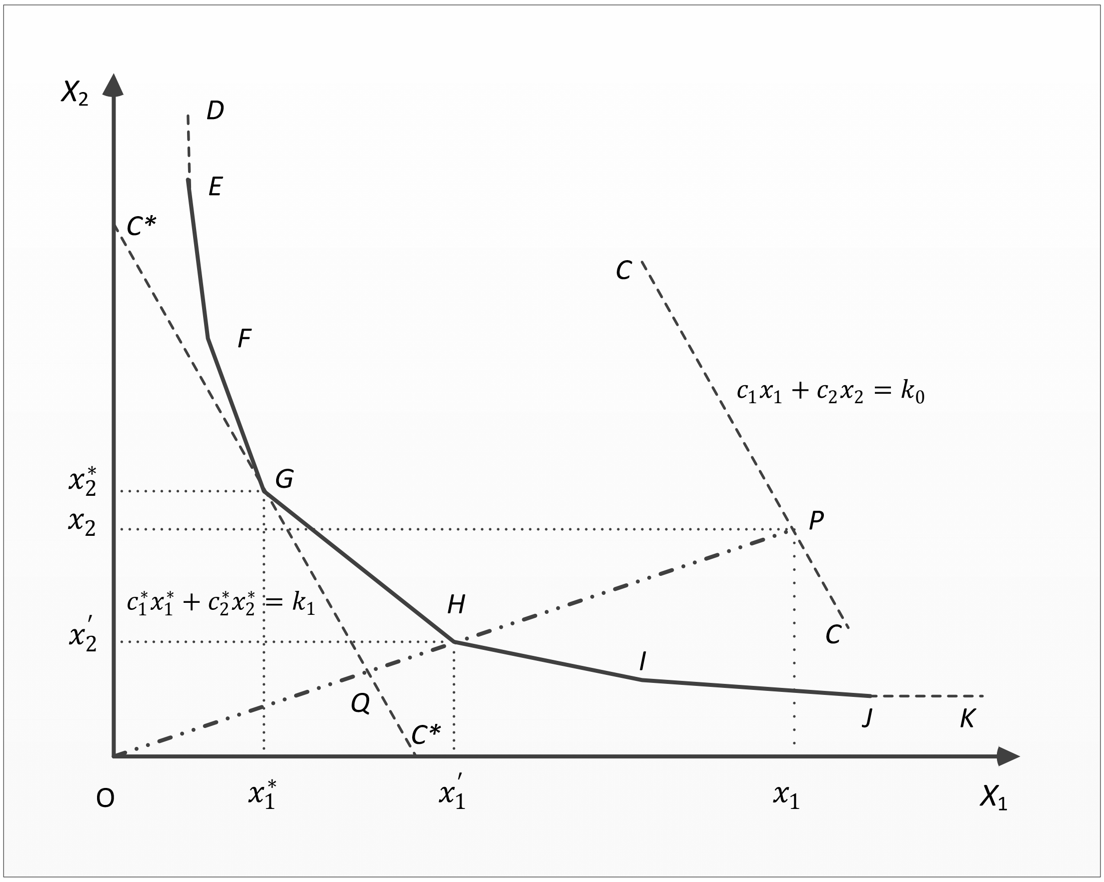
Generally, cost efficiency formula can be rewritten as:

$$CE = AE \ x \ TE \tag{3.18}$$

III.4. Efficiency in Microfinance Context

As previously discussed in Section I.1.5.2, there have been dichotomy to some extent in regard to microfinance performance measurement stemmed from contrasting approaches to microfinance as reported in Section II.3.2.4; most performance measurement in microfinance studies have used the traditional financial performance ratios as widely used in traditional institutions[1], whilst other studies implemented qualitative measures exclusively in measuring MFI achievement. Since microfinance has actually double bottom objective encompassing its social and financial missions, it is therefore imperative to seek for more comprehensive criterion in microfinance performance that can incorporate these two objectives.

Figure 3.6: Technical, Allocative and Economic Efficiency



Source: (Thanassoulis, 2001), redrawn and modified by author

This research thus proposes efficiency as an adept performance criterion for microfinance, i.e. the modern concept of efficiency that takes account all the inputs in the transformation process to produce all outputs. More specifically, it refers to the frontier

[1] An example of this is five indicators of microfinance performance listed in MicroBanking Bulletin 2006 although termed as 'efficiency' measures yet they are essentially performance ratios (Balkenhol, 2007).

efficiency, i.e. to what extent that an MFI have optimally utilises its inputs to reach its objectives (its 'outputs') in comparison to a benchmark frontier that represent efficient production. From the perspective of efficiency, the dual objectives of output to the poor (MFI's social objective) and financial sustainability (MFI's financial objective) can be perceived as MFI's ***social*** and ***financial efficiency***, respectively. Another criterion that is proposed in this research is ***overall efficiency***, whereby an MFI is measured in using its inputs to achieve all its overarching objectives, i.e. in achieving its social and financial objectives concurrently.

In the three measures above, MFI efficiency, as its performance yardstick, will be calculated relative to the efficient frontier as benchmark. It is a normative efficiency as per Ray (2004) whereby the closer an MFI to the efficient frontier, the optimal its transformation process. Thus, with overall efficiency measure, this research intends to capture the overall performance of MFI, overlooking one-sided perspective of trade-off between outreach and financial sustainability. Social and financial sustainability would thus serves as secondary, more detailed information on how MFI achieve these two objectives, respectively.

In this research, technical efficiency will be the focus in the analysis due to nature of price unavailability for MFIs' output i.e. dual bottom objectives of outreach; this is common for third sector institutions such as MFI. Moreover, the data on the price for some inputs are typically not available, e.g. price for assets or employee/personnel. Another reason to focus on technical efficiency is that the source of inefficiency in MFI is the disparity between intended and actual performance, i.e. the problem related to that explained by agency theory, such as managerial capability, field operators' motivation and field implementation of head office's policy.

III.5. Summary and Discussion

This chapter gives the theoretical background to this research. It firstly provides the worldview theory of how one firm have difference performance than another. Neoclassical theory of firm, which stated that all surviving firms in the market are the efficient ones, is not capable to explain why the inefficient firms exist. Managerial theory of the firm starts to refine the notion by dropping the assumption that the operator of the firm is also its owner; thus, it brings with it the difference motivation as reason why firm may not be efficient. This notion is explored more in agency theory and X-efficiency theory, which are the basis in explaining firm’s inefficiency. Subsequently, this chapter moves into explaining the concept of efficiency and productivity from the perspective of production theory, i.e. describing the conceptual differences between these two notions, in addition to presenting the theoretical concepts of technology, Pareto optimality, return to scale and different types of efficiency. All these concepts are essential in understanding the context and flow of this research.

Chapter IV: Data Envelopment Analysis and Malmquist Productivity Index

IV. 1. Introduction

This chapter describes thoroughly the methodological approaches in efficiency measurement and productivity analysis that can be implemented in this study. Section IV.2 presents different efficiency measurement methods from traditional ratio analysis, which is still hitherto used in current business and practical world, to modern, more comprehensive performance measure of frontier-based efficiency. Two types of frontier-based efficiency analyses of parametric and non-parametric analyses are introduced and discussed herein conceptually. The subsequent Section IV.3 discusses the advantage of non-parametric method of DEA in the context for this study thus its application in this study, thereafter Section IV.4 proceeds to examine two basic models of DEA in detail, i.e. the basic CRS-based Charnes, Coopers, and Rhodes model (Charnes et al., 1978), VRS-based Bankers, Charnes, and Coopers model (Banker, Charnes, & Cooper, 1984). Section IV.4 then discusses the two assessment framework for analysing performance of financial institutions.

The following Section IV.6 deals with the three approaches of DEA-based Malmquist productivity index as measurement for productivity analysis, i.e. the CRS-based Färe, Grosskopf, Norris, and Zhang model (Färe et al., 1994), the VRS-based Ray and Desli modification model (Ray & Desli, 1997), and finally the Circular Malmquist Index from Pastor & Lovell (2005) with its VRS modification by Portela and Thanassoulis (2008), of which the latter will be implemented in the third study of this research. The advantage of Circular Malmquist Index over the regular Malmquist Index in regard to unbalanced panel data will also be discussed herein, thereafter followed by the argument for choosing the VRS-based Circular Malmquist Index for this study that is presented in subsequent Section IV.7. Finally, Section IV.8 closes this chapter with a summary.

IV.2. Approaches in Efficiency Measurement

IV.2.1. Performance Ratio Approach

As previously described in Section III.3.4, the traditional method in efficiency measurement is by using a performance ratio indicator, i.e. by using a ratio relating one selected output to one selected output. An example of this method in the field of microfinance is several performance ratios suggested by CGAP such as return on asset, return on equity, current recovery rate, and write-off ratio. Specifically for efficiency, CGAP suggested two ratios, i.e. operating expense to gross loan portfolio and cost per borrower/cost per loan (Rosenberg, 2009) . On the other hand, MicroBanking Bulletin 2005 suggested additional two performance ratio to measure operational efficiency, i.e. personnel expense/loan portfolio and average salary/GNI per capita (Balkenhol, 2007).

Nevertheless, there are several weaknesses in this method. First, the partiality problem related to this method. Efficiency measurement by way of performance ratio methods face the same partiality problem akin to the conventional financial indicator methods i.e. it can only capture the complete performance if and only if there is only one input and one output in the whole production process. Since most, if not all, production processes in the real world involve multiple inputs and multiple outputs then this method could not capture how these multiple inputs affect each other and simultaneously affect multiple outputs in the production process (Thanassoulis, 2001). This means that only partial evaluation of performance can be provided (Bogetoft & Otto, 2011), which will be problematic if one firm excels in one ratio but fails in others. Firm stakeholders, may face confusion in benchmarking firm's overall performance against other firms, which is essential to drive performance in the future.

Secondly, the aggregation problem exists herein. When ratio method is attempted to be used to measure productivity and efficiency in a firm employing multiple inputs and multiple outputs, these multiple inputs and multiple outputs need to be aggregated into one input and one output. However, aggregation problem will occur herein. This aggregation problem will also ensue when several partial indicators are attempted to be combined into one assessment criterion (Fluckiger & Vassiliev, 2007). Likewise, basing performance to single indicator overlooks any substitutions, interactions and trade-offs between several performance measures (Bogetoft & Otto, 2011; Zhu, 2003).

Thirdly, the incorrect overlapping usage of efficiency and productivity as described in Section III.3.4. Productivity captures the descriptive performance in a given time whilst efficiency is defined as normative firm performance, hence the need to be compared to a set of benchmarks. This leads to the fourth problem, which is how to choose the benchmark for the performance. In most cases, the benchmark to which these ratios are being compared is the average of performance ratios of other firms in the region or industry assessed. This raises a problem that the firm performance is being compared to the mediocre average performance rather than the best performance, thus being able to outperform the mediocre performance does not mean that a firm has performed the best. If it were to be compared to the best performance in the industry or region assessed, then the question will be how to choose the benchmark so that a commensurable comparison can be made; the effect of economies of scale often make two firms incomparable (Thanassoulis, 2001).

IV.2.2. Modern Efficiency Measurement

Modern efficiency measurement methods offer an alternative in performance measurement than traditional ratio methods, which attempt to fully assess the firm production process involving multiple inputs – multiple outputs rather than relying on partial performance measures from performance ratio (Thanassoulis, 2001). These modern approaches employ frontier-based efficiency methodologies originated from the seminal work of Farrell (1957), which was covered previously in Section III.3.8. Frontier-based methodologies measure firm efficiency by comparing its performance relative to efficient production frontier constructed from a set of best-practice firms in the industry, i.e. fitting the efficient frontier onto the data (Berger & Humphrey, 1997; Greene, 2008). There are two main approaches in this regard, i.e. the parametric (econometric) approach and non-parametric (mathematical programming) approach. Section IV.2.2.1 and Section IV.2.2.2 below briefly illustrate these approaches. This study itself focuses on non-parametric method of DEA and non-parametric DEA-based total factor productivity growth analysis, thus these methodologies will be described more thoroughly in later section of this chapter.

IV.2.2.1. Parametric (Econometric) Approach

As the name suggests, parametric approach to efficiency measurement utilises econometric approach in constructing technically maximum feasible output as efficient frontier to which firm performance in the dataset is compared. In this approach, aberration from the efficient frontier is decomposed into deviation due to technical inefficiency and that due to random errors, which is the main advantage of this approach. The efficient frontier herein is constructed using specific production, revenue, or cost functions. Consequently, it requires explicit assumptions to specify the shape of production, revenue, and cost functions, as well as distribution of the random error terms and the inefficiencies.

There are three main econometric frontier methods in this approach, i.e. stochastic frontier analysis (SFA), thick frontier analysis (TFA), and the distribution-free analysis (DFA), of which differences being the distributional assumptions of the random components and inefficiencies. These three main approaches are discussed at length, among others, in Cummins & Weiss (2000) and Berger & Humphrey (1997).

The most widely used method in this approach, SFA assumes that the error components adhere to symmetric distribution, i.e. normal distribution, whilst inefficiencies is distributed asymmetrically, i.e. mainly half-normal, exponential and gamma distribution. Many studies on microfinance efficiency as well as financial efficiency in general had employed SFA in their methodology thus it will be subsequently covered in more detail in this section. TFA on the other hand specifies functional production function but does not state any assumption for the distribution of inefficiencies and error components; TFA assumes that there is an inefficiency differences between performance of firms in the highest and lowest cost quartile and that random error component also presents therein. Its main difference with both SFA and also DFA is that it aims to present the general level of overall efficiency but not individual efficiency for each firms in observation (Berger & Humphrey, 1997), thus it is not appropriate to be utilised in this study.

Finally, as with TFA, DFA also assumes a production function for the efficient frontier but not strict assumptions for its inefficiencies and random error components. Yet, in DFA efficiency for each firm is assumed to be constant over time whilst random error component has a tendency to be averaged to zero. Since the inefficiency estimation for each firm in dataset herein is determined by the difference between each firm's average residual and average residual of efficient firms on the frontier, thus in the case whereby a firm's efficiency is changing over time due to changing conditions DFA would measure its average efficiency distance to the frontier as opposed to its efficiency at a specified time. For this reason, DFA is not suitable to be applied in this particular study as one of the objectives of the study is to calculate productivity change over time hence the need for efficiency measures at specified time for each firm in database.

Stochastic Frontier Analysis

SFA was originated by two seminal papers, i.e. Aigner et al. (1977) and Meeusen and van den Broeck (1977), which was followed by Batesse and Corra (1977). It has been a very popular parametric approach to efficiency measurement, especially in financial institution efficiency (Berger & Humphrey, 1997). SFA estimates firms' efficiency relative to efficient frontier by taking into account any measurement errors and/or other sources of statistical noises that may arise, i.e. the *stochastic* element. The main idea is that a firm's deviation from the efficient frontier may not necessarily under its control. Any deviation from the efficient frontier could thus be decomposed into two elements, i.e. firm's technical inefficiency and the statistical noise in the dataset.

The main idea of the SFA model can be summarised in the following[2]. Firstly, an econometric-based production frontier model can be written as:

$$y_i = f\left(x_i;\beta\right) \cdot TE_i \qquad i = 1,\ldots,N \tag{4.1}$$

[2] See Kumbhakar & Lovell (2000) for detailed description of SFA models.

Where y_i refers to scalar output of ith firm, x_i denotes the vector of inputs used by ith firm, $y_i = f(x_i;\ \beta)$ signifies the production function describing the relationship of output and inputs, β is coefficient representing the vector of technology parameter be estimated, whilst TE_i is the technical efficiency of ith firm ($0 \leq TE_i \leq 1$). This model is a *deterministic production frontier* model; it postulates that the deviation between firm's technically maximum output and its actual output is due solely to its technical efficiency. Aigner & Chu (1968) proposed the use of log-linear Cobb-Douglas production function in the deterministic frontier function as in equation (4.1) above.

Nevertheless, this specification disregards the fact that not all deviation is under firm control, i.e. the difference between actual and maximum output can be caused by firm-specific random shocks which is outside of firm's control. Therefore, these firm-specific random shocks are thus integrated into the analysis by postulating a *stochastic production frontier* as follows:

$$y_i = f\left(x_i;\beta\right)\ \cdot\ \exp\left\{v_i\right\}\ \cdot\ TE_i \qquad i = 1,\dots,N \tag{4.2}$$

The first part of the equation (4.2) above, $[f(x_i;\ \beta)\ \cdot exp\{v_i\}]$, is a stochastic production frontier, whereby $y_i = f(x_i;\ \beta)$ is the deterministic part applicable to all firms whilst $exp\{v_i\}$ denotes the stochastic component representing the effect of a firm-specific random shocks.

Subsequently, TE_i can also be written as $TE_i = exp\{-u_i\}$ whereby u_i is the technical *inefficiency* of firm i, thus equation (4.2) can be rewritten as:

$$y_i = f\left(x_i;\beta\right)\ \cdot\ \exp\left\{v_i\right\}\ \cdot\ \exp\left\{-u_i\right\} \qquad i = 1,\dots,N \tag{4.3}$$

Equation (4.3) above is a basic equation for parametric approach to efficiency measurement in *multiplicative* format. An explicit choice of production function would then be assumed in the place of the stochastic production function $[f(x_i;\ \beta)\ \cdot exp\{v_i\}]$ above. Equation (4.3) can also be presented in the *additive* format (Bogetoft & Otto, 2011) as follow:

$$y_i = f\left(x_i;\beta\right) + v_i - u_i \qquad i = 1,\dots,N \tag{4.4}$$

Thus in the parametric approach, v_i is the stochastic term representing two-sided statistical error and stochastic nature in production process, whilst u_i is a non-negative technical inefficiency component. Due to these two components, the stochastic production frontier model is also termed as *composed error* model.

The first step in parametric approach is to establish an explicit assumption regarding the production function for equation (4.3) or (4.4). Studies using SFA, as well as other parametric methods, have employed various functional forms to describe the relationship between input and output in the dataset. The early SFA models, e.g. in Aigner et al. (1977) and Meeusen and van den Broeck (1977), are based on the log-linear Cobb-Douglas functional form. Cobb-Douglas production function itself offers simplicity hence its popularity. The SFA model based on the log-linear Cobb-Douglas production function thus can be presented as the following:

$$\ln y_i = \beta_0 + \sum_{j=1}^{m} \beta_j \ln x_{ij} + v_i - u_i \tag{4.5}$$

$$i = 1,2,...,N; \quad j = 1,2,...,m$$

Despite its simplicity in estimation, Cobb-Douglas have limitations in which it can only estimate global returns to scale, i.e. it does not allows varying returns to scale between firms in the dataset. In addition to that, the elasticity of substitution for its inputs is restricted to unitary[3] and this specification does not allow second-order effects of inputs, i.e. quadratic (non-linear relationship) of inputs and interaction terms between inputs.

Another functional form that is used mostly in SFA studies (Greene, 2008) is transcendental logarithmic – or translog – production function introduced by Christensen et al. (1973). It is essentially a generalisation of Cobb-Douglas function which offers more

[3] An elasticity of substitution of one denotes a unitary substitutability, i.e. the use of one input of production is independent to the use of another inputs; the elasticity of substitution is in between perfectly inelastic (elasticity of substitution equals zero, i.e. inputs are not substitutable) and perfectly elastic (elasticity of substitution equals infinity, i.e. inputs are perfectly substitutable). Thus, the isoquants will be convex to the origin.

flexibility by providing second order approximation by way of quadratic and interaction terms. Moreover, returns to scale are permitted to be varied both between firms in dataset and there is less restriction in terms of elasticity of substitution. The translog functional form for stochastic frontier production function can be specified as follows:

$$\ln y_i = \beta_0 + \sum_{j=1}^{m} \beta_j \ln x_{ij} + \frac{1}{2}\sum_{j=1}^{m}\sum_{k=1}^{m} \beta_{jk} \ln x_{ij} \ln x_{ik} + v_i - u_i \tag{4.6}$$

$$i = 1,2,...,N; \quad j = 1,2,...,m; \quad k = 1,2,...,m$$

The first part of the equation (4.6), $\ln y_i = \beta_0 + \sum_{j=1}^{m} \beta_j \ln x_{ij}$, is identical to Cobb-Douglas production function, whilst the next part, $\frac{1}{2}\sum_{j=1}^{m}\sum_{k=1}^{m} \beta_{jk} \ln x_{ij} \ln x_{ik}$, is the interaction terms of input which gives the model its flexibility regarding second-order approximation over model based on Cobb-Douglas forms, i.e. how inputs influenced each other.

Besides these two functional forms, there are many other functional forms that are utilised in the SFA studies, e.g. quadratic, constant elasticity of substitution (CES), normalised quadratic, and generalised Leontief. One can refer to Bogetoft and Otto (2011) and Coelli et al. (2005) for detailed discussions on all these functional forms.

Equation (4.5) and (4.6) cannot be solved using conventional OLS regression due to the presence of the composed error term. Indeed, this composed error term in the stochastic production frontier models can be regarded as a decomposition of the error term, ε_i, in the OLS regression, such that:

$$\varepsilon_i = v_i - u_i \tag{4.7}$$

Therefore, what is needed herein is the method to decompose the error term in the conventional OLS into two components of composed error above. So OLS can be used as the first step to solve the stochastic frontier models but further advanced method is needed to decompose the error term.

In order to do this, the distribution of these two composed error components needs to be established. Whilst the stochastic component, v_i, is assumed to be two-sided normally-distributed as in standard error term with zero mean, the distribution of non-negative u_i is unknown; Thus, an explicit assumption of u_i is needed. Greene (2008) expansively discussed all possible distribution for this decomposition. The most commonly used distributions for technical inefficiency u_i in SFA are half-normal distribution and exponential, whilst other more complicated distributions such as gamma and truncated normal distributions can also be utilised.

Subsequently, the composed error term is estimated and decomposed in SFA by employing Maximum Likelihood Estimation (MLE), which estimates the production function parameters such that the highest possible joint probability of observing the sample is achieved. This is done by initially constructing joint probability distribution of the composed error term, followed by constructing the log likelihood function that match the inputs – output relation of the sample data based on the result, and finally finding the matching set of parameters that maximises the log likelihood through various iterations. Thereafter, the conditional mean of technical inefficiency are calculated using estimators, the common of which are Battese and Coelli or BC estimator (Battese & Coelli, 1988) and Jondrow, Lovell, Materov and Schmidt or JLMS estimator (Jondrow et al., 1982). These two estimators produce similar estimation of technical inefficiency so the choice of either one would not be detrimental to the efficiency calculation (Greene, 2008).

IV.2.2.2. Non-Parametric Approach: Data Envelopment Analysis

The alternative modern method in efficiency measurement is the non-parametric approach. This method seeks to employ mathematical programming in constructing the efficient frontier to which units in the dataset are assessed. This method stems from the seminal work of Farrell (1957) of productive efficiency measurement in a single input-output situation. Farrell's idea was thus developed further by Charnes et al. (1978), who proposed a mathematical programming algorithm in the efficiency measurement, i.e. Data Envelopment Analysis or DEA. DEA is the primary methodology in non-parametric approach in efficiency measurement (Fried, Lovell, & Schmidt, 2008). It assesses efficiency from a set of homogeneous economic agents which is individually termed as ***decision***

making unit (DMU), which is related to agents' ability to have control over the transformation of inputs into outputs. DMUs are considered to be homogeneous if they use similar input resources in producing similar outputs despite in varying amounts (Thanassoulis, 2001).

DEA seeks to construct an efficient frontier from best-performing DMUs in the dataset using linear programming, which will be the benchmark to which performance of all other DMUs in the dataset are measured. The deviation from the efficient production frontier is regarded as technical efficiency, i.e. it does not accommodate for statistical noise. Therefore, the efficient frontier that is constructed using linear programming algorithm envelops the data more tightly than the deterministic production frontier (Fried et al., 2008). This is due to the fact that, as opposed to parametric approach to efficiency that seek to create central tendency by fitting a single regression plane at the centre of all the DMUs to create the ideal average measure as benchmark of all DMUs, by virtue of linear programming DEA seek to form a 'floating' piecewise linear production frontier on top of all the data as best-practice efficient production frontier to be the benchmark against which performance of each DMUs will be compared, hence the term 'envelopment' since the floating frontier tightly envelop the DMUs in the dataset (Cook & Zhu, 2005; Emrouznejad & Anouze, 2010; Fluckiger & Vassiliev, 2007). The example of piecewise linear frontier can be seen at Figure 3.4 for input- and output-orientated approach.

DEA is capable in measuring efficiencies in transformation process with multiple inputs and multiple outputs without *a priori* assumption on the distribution and production function (Cook & Zhu, 2005; Cooper, Seiford, & Zhu, 2004); instead, it uses minimum extrapolation approach to construct the frontier whilst maintaining monotonicity and convexity tenets of production possibility set in economics (Banker et al., 1984). Several DMUs for which efficiency are maximised to create this enveloping piecewise frontier are referred to as reference set, of which benchmark for each DMU observed will then be identified from those with similar inputs or outputs mix. Efficiency score is then calculated from the distance of each DMU to the reference set on the frontier thus creating relative efficiency measure for all DMUs (Cook & Zhu, 2005; Cooper et al., 2004; Emrouznejad & Anouze, 2009). Accordingly, a unique reference set has to be built for each DMU hence may vary for different DMU. By performing this procedure, DEA detects sources and calculates amounts of inefficiencies in each input and output for each DMU, which thereafter can be interpreted into amounts of input and output that have to be changed to make each DMU efficient to the benchmark (Habibov & Fan, 2010).

Since DEA does not require an explicit assumption of production function and inefficiency distribution, DEA can be applied for efficiency measurement in a situation where the relationship of inputs and outputs in the transformation process is not apparent, such as in a public sector, not-for-profit environment. DEA itself originally developed in Charnes et al. (1978) to assess technical efficiency in education sector. Should there be information regarding price of inputs, DEA also enables the calculation of allocative and economic efficiency. This is one of the strengths of DEA. In addition to this, the efficient production frontier constructed by DEA is a piecewise frontier consisting of actual efficient DMUs whose performance can be emulated by DMUs having similar input-output mix. On the other hand, efficient frontier constructed in parametric approach is ideal outputs; an 'average' of the dataset, i.e. a regression plane drawn at the centre of the dataset. One can refer to extensive literatures for comparison between DEA and SFA comprehensively, e.g. Ratchford (2012) which had made excellent comparison with a comprehensive summary table.

The technical specification of DEA models will be described in the later section of this chapter. Other non-parametric frontier model that has been used in efficiency studies is the Free Disposal Hull (FDH) model introduced by Deprins et al. (1984). Tulkens (1993) provides further detailed discussion on this method.

IV.3. Assessment Framework in Financial Institutions Performance

Since this research focuses on performance of financial institutions, i.e. microfinance institutions, it is thus important to observe different approaches regarding financial institutions performance measurement in existing literatures. There are two main approaches in performance measurement of financial institutions, i.e. ***production*** or ***intermediation approach*** (Athanassopoulos, 1997; Berger & Humphrey, 1997; Fethi &

Pasiouras, 2010). 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 excess funds to produce outputs of loans and other financial services to economic agents in deficit (Athanassopoulos, 1997; Kipesha, 2012).

Thus, the main contrast between these two approaches is the role of deposit, i.e. as output in production approach but as input in the intermediary approach (Balkenhol, 2007; Gutiérrez-Nieto et al., 2007).

IV.4. Methodology Selected In this Study

In the context of this study, non-parametric approach of DEA will be selected as methodology in the analysis, instead of parametric approach such as SFA, due to the following reasons. Firstly, in the context of microfinance studies, the relationship between multiple inputs and multiple outputs in transformation process is typically, if not utterly, inexplicit; especially for not-for-profit MFIs which accounted for majority MFIs operated globally and are the focus of this study. Consequently, establishing assumption on appropriate form of its production function is challenging at best. DEA is thus appropriate to be employed herein as it does not require an explicit a priori assumption or any restrictions on the functional form of production relationship between inputs and outputs, or any need for distributional assumptions regarding firm-specific inefficiency (Kalirajan & Shand, 1999). In the conclusion of their study, Kalirajan & Shand (1999) argues that DEA is more appropriate to be utilised in a situation where there is a weak knowledge about underlying technology, which is commensurate with the context of microfinance analysis.

The main concern in utilising SFA is that, irrespective of the estimator selected (e.g. either JLMS or BC estimator) the final efficiency estimates are statistically inconsistent by reason of the nature of SFA approach (Giraleas, 2013). The statistically inconsistent estimate herein means that the estimate value of u_i (technical inefficiency) does not necessarily converge to the true value of u_i. An exception to this is when SFA is utilised under panel data settings and only if it utilises a time-invariant technical efficiency assumption, i.e. when it is assumed that technical inefficiency is allowed to vary across firms but is assumed to be constant for each firm over the period of the analysis. For further reference, Kumbhakar and Lovell (2000) discuss this matter comprehensively.

The time-invariant technical efficiency assumption is thus a strong assumption, which may be relevant in a short period panel data, short interval panel data, e.g. monthly or weekly interval, or in the absence of competition (Collier et al., 2011; Kumbhakar & Lovell, 2000). However, in a very competitive and dynamic environment such as microfinance operation and in the panel data used herein, time-invariant technical efficiency assumption is very restrictive; especially in the productivity growth analysis.

Secondly, as discussed in Section IV.2.2.2 above, the efficient frontier in DEA is constructed from actual performance of the best performing DMUs in the dataset; it is in the form of floating piecewise linear frontier created from these best-performing DMUs (as fully-efficient DMUs) that tightly envelops all the other DMUs in the production possibility set. This means that the benchmarks for efficiency measurement in DEA are *actual* best performance of some DMUs in dataset, whilst the efficient frontier in SFA is constructed from a regression line that runs on the central plane of the data hence a *normative* frontier. Accordingly, DEA enables inefficient DMUs to emulate the performance, i.e. input-output specification, of benchmark DMUs – their *efficient peers* – assigned by DEA to improve their efficiency. These efficient peers of a particular DMU in production possibility set are fully-efficient DMUs (whose efficiency equals to one) that have identical input-output characteristics with the assessed DMU.

It is argued herein that this DEA property is a very important advantage in performance analysis, since efficient peers of each MFI can thus be identified and be emulated thereafter to boost the future performance. This property enables policy recommendation to be prepared and submitted to MFIs and MFIs' stakeholders in region observed, i.e. one of the objectives in this study.

Thirdly, due to its root in linear programming, the nature of DEA approach is such that the transformation process involving multiple inputs – multiple outputs can be dealt with in a primal approach, even in its basic models, without the need for additional data on input prices. This is one of the most important advantages of DEA over SFA and other parametric-based approach (Collier et al., 2011). On the other hand, SFA and other parametric-based method in their basic forms are geared toward handling transformation process with one output (Collier et al., 2011; Ratchford, 2012). Multiple outputs can be assessed using extended models; a cost frontier can be estimated to achieve cost minimisation whilst maintaining a given level of multiple outputs (input-orientated) e.g. in Gong and Sickles (1989), Kumbhakar and Lovell (2000), and Hermes et al. (2011), whilst a revenue frontier can be estimated to achieve outputs maximisation in a multiple outputs setting given a constant level of inputs e.g. in Oliveira et al. (2013). Profit frontier can also be estimated in profit maximisation effort involving multiple inputs and multiple outputs (Kumbhakar & Lovell, 2000). However, these require additional data on price of inputs and/or price of outputs. Where data on price of inputs and/or outputs are not available, stochastic distance function (SDF) can be utilised for a multiple inputs – multiple outputs setting, i.e. by using an output distance function, which is a dual to a revenue frontier, to estimate output-orientated technical efficiency, whilst an input distance function can be used to estimate input-orientated technical efficiency as it is a dual to a cost frontier, e.g. in Atkinson et al. (2003), Coelli and Perelman (1999), Grosskopf (1996) and Kumbhakar and Lovell (2000). Notwithstanding these extensions, the selection and application of appropriate model to handle endogeneity problems (i.e. when explanatory variables are correlated to u_i or v_i) have not been sufficiently addressed (Gocht & Balcombe, 2006).

One of the research aims in this study is to propose a reliable and duplicable method to measure and to benchmark MFIs' performance in regional and global frontiers which can be proposed to microfinance institutions and stakeholders as an accessible comprehensive method to monitor microfinance performance. Thus, the idea highlighted in this point, which is the advantage of DEA due to its readiness and practicality in handling performance analysis in multiple inputs – multiple outputs environment, makes DEA a more suitable methodology herein.

Finally, DEA enables a non-orientated efficiency measurement analysis to be performed with non-orientated specification such as non-orientated hyperbolic DEA model used in the second and third studies of this thesis (Chapter VI and VII). In this approach, an inefficient DMU in the analysis can reduce its input and increase its output simultaneously to reach the efficient frontier. This model will be described in the second study in Chapter VI. The future study will endeavour to develop a flexible non-oriented DEA model based on directional distance function, which aims to enable efficiency to be measured by pursuing different proportion of input saving and output expansion based on MFIs' conditions.

In regard to assessment approach as discussed in Section IV.3, many IMFIs and their conventional MFIs in dataset are not collecting deposit due to lack of authorisation to mobilise deposit or any other reasons, i.e. similar to dataset condition used in Servin et al. (2012) . Consequently, many MFIs are still depending on outside funding, commercial or charitable, to fund their operation, as opposed to its own deposit as source of funds. As per MFI literatures and also author's anecdotal field observation in Indonesia, many MFIs that indeed collect obligatory deposits or encourage voluntary deposits only collected very small deposit in order to build a safety net for clients in case of loan arrears, i.e. to pay for monthly loan instalment when the clients' business are in difficulty. Therefore, it is proposed that production approach is applied herein. This is parallel to 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). These can be seen in Table 4. Some studies combined these two approaches, as can be observed in the said table, yet this research argues that production approach is more appropriate in the context of microfinance assessment.

IV.5. Data Envelopment Analysis

This section methodically explores basic DEA models to provide basic understanding to this methodology. Specifically, it explores Charnes, Cooper and Rhodes model as the original DEA model introduced in Charnes et al. (1978) which is based on

CRS assumption and the VRS-based Banker, Charnes, and Coopers model from Banker et al. (1984).

IV.5.1. Charnes, Cooper, and Rhodes (CCR) Model

CCR model is the original DEA model introduced in Charnes et al. (1978) whereby technical efficiency is estimated under the CRS condition hence referred as CRS model (Cooper et al., 2004). Its main idea is to first linearly aggregate multiple inputs and multiple outputs in each DMU into a single 'virtual' input and output, weighted in such a way that will maximise Pareto efficiency for the respective DMU. Thus, the virtual inputs and output relation would then be arranged in the following terms:

$$\text{Virtual Input} = v_1 x_1 + \ldots + v_i x_i = \sum_{i=1}^{m} v_i x_i \qquad i = 1,2\ldots,m$$

$$\text{Virtual Output} = u_1 y_1 + \ldots + u_r y_r = \sum_{r=1}^{s} u_r y_r \qquad r = 1,2,\ldots,s \tag{4.8}$$

In the equation (4.8) above, v_i and u_r represents weights assigned to input x_i and output y_r for the linear aggregation respectively. Variable x_i and variable y_r are actual inputs and outputs observed in each DMU. Efficiency score is assigned for every DMU in the best possible way so as to maximise the ratio of its average productivity as discussed in Section III.3.4, i.e. the ratio of its virtual weighted output to weighted input (Charnes et al., 1978). The model used to depict the average productivity which will be used thereafter to maximize the efficiency can be written as follow:

$$\text{Average Productivity} = \frac{\text{virtual output}}{\text{virtual input}} = \frac{\sum_{r=1}^{s} u_r y_r}{\sum_{i=1}^{m} v_i x_i} \tag{4.9}$$

The efficiency of DMU$_0$ (DMU to be assessed) is then calculated as maximum of its average productivity, i.e. maximum of its weighted outputs to weighted inputs subject to condition that ratios for all *N* DMUs to be less than or equal to unity, as follow:

$$\text{Max } h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \tag{4.10}$$

Subject to:

$$\frac{\sum_{r=1}^{s} u_r \, y_{rj}}{\sum_{i=1}^{m} v_i \, x_{ij}} \leq 1 ; \qquad j = 1, 2, \ldots, N$$

$$u_r, v_i \geq 0 ; \; r = 1, 2, \ldots, s ; \; i = 1, 2, \ldots, m$$

In equation (4.10) above, h_0 is the measure of efficiency of assessed DMU$_0$; x_{ij} and y_{rj} are the *i*th input of *j*th DMU and *r*th output of *j*th DMU respectively. Thus, the vector (x_{i0}, y_{i0}) are the input-output of the assessed DMU$_0$. Moreover, v_i and u_r are the weights of *r*th input and *j*th output, respectively, obtained from the linear programming. They are calculated so that the assessed DMU$_0$ achieves the best possible efficiency score. Each individual DMU has its own set of weights ranging from 0 to unity.

Since equation (4.10) above can results in infinite solutions, Charnes et al. (1978) transformed the ratio model above into equivalent linear programming model as follows:

$$\text{Max } z_0 = \sum_{r=1}^{s} \mu_r y_{r0} \tag{4.11}$$

subject to:

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \; ; \qquad j = 1,2,\ldots,N$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

$$\mu_r, v_i \ge 0; \quad r = 1,2,\ldots,s; \quad i = 1,2,\ldots,m$$

Subsequently, equation (4.11) is solved through its dual form as the following:

$$\theta^* = \text{Min } \theta \tag{4.12}$$

subject to:

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

$$\sum_{j=1}^{N} \lambda_j x_{ij} \le \theta x_{i0} \; ; \qquad i = 1,2,\ldots,m$$

$$\lambda_j \ge 0; \quad j = 1,2,\ldots,N$$

Equation (4.12) seeks optimal solutions for assessed DMU_0 relative to other DMUs located on the frontier with similar input-output mix as benchmark. It computes optimal solutions (θ, λ) for assessed DMU_0 and other DMUs relative to DMU_0, whereby θ is the efficiency score for the particular DMU_0 that represents an equiproportional measure of technical efficiency. This equation is subject to a constraint set that bound the value of θ to be less than or equal to unity relative to other DMUs, in which most technically efficient DMUs will have θ = 1 whilst most technically inefficient DMUs will have θ = 0. In this equation, λ is the interpolation multiplier assigned to DMU_j (j=1,2,…,N) to construct the efficient producer for assessed DMU_0. An optimal λ for a particular DMU_j, i.e. λ_j = 1, indicates that this particular DMU_j is located on the frontier and a benchmark for assessed DMU_0 which has similar input-output mix.

Equation (4.12) thus creates a piecewise linear production frontier enveloping all DMUs in a production possibility set. The piecewise linear frontier in a two inputs – one output scenario is visualised in Figure 3.4 (A) in Section III.3.3 of Chapter III. As can be seen in the above figure, there may be segments of the frontier that run parallel to the axes. In this case, efficient DMU(s) that are located in the segments of production frontier parallel to the axes, such as DMU D and K in Figure 3.4, are considered as weakly efficient since a multiple optimal solution is possible from multiple inputs combination (Cook & Zhu, 2005).

In the scenario in Figure 3.4, DMU D can still reduce input x_2 to the level used by DMU E and still be efficient, whilst DMU K can still be fully-efficient if it reduces its use of input x_1 to the level used by DMU J. This individual reduction possible is termed as *slack*, i.e. *input slacks* in this case. In equation (4.12), actually both input and *output slacks* may be present from the constraints in the following form:

$$
\begin{aligned}
s_i^- &= \theta x_{i0} - \sum_{j=1}^{N} \lambda_j x_{ij} \quad ; \qquad i = 1,2,\ldots,m \\
s_r^+ &= \sum_{j=1}^{N} \lambda_j y_{rj} - y_{r0} \quad ; \qquad r = 1,2,\ldots,s
\end{aligned}
\tag{4.13}
$$

The possible existence of input and output slacks are represented by variables S_i^- and S_r^+, respectively in the equation (4.13) above. Consequently, these slacks in equation (4.13) can be incorporated into equation (4.12) into a two-stage linear programming model that also accommodates the existence possibility of nonzero slacks in DEA computation (Cooper et al., 2004; Thanassoulis, 2001) as the following:

$$
\text{Min } \theta - \varepsilon \left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right) \tag{4.14}
$$

subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} + s_i^- = \theta x_{i0}$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} - s_r^+ = y_{r0}$$

$$0 < \varepsilon << 1$$

$$\lambda_j \geq 0; \quad j = 1,2,\ldots,N; \quad r = 1,2,\ldots,s; \quad i = 1,2,\ldots,m$$

Equation (4.14) utilises ε, which is an infinitesimal non-Archimedean constant ($0 < \varepsilon << 1$) so that the minimisation over θ is prioritised over the optimisation involving slack variables (Cook & Zhu, 2005; Thanassoulis, 2001). As a result, this equation is computed in two-stage process: firstly, a minimisation of inputs over θ via the optimal θ^* in left hand side of equation ignoring slack variables – as per Equation (4.12). Thereafter, a maximization of the slack variables is pursued to yield optimal set of slack values that will ensure the value of θ^* cannot be reduced further to accommodate further increase in the slack values (Thanassoulis, 2001). Equation (4.14) above is referred to as ***envelopment* DEA model** since it measures efficiency relative to production possibility frontier that envelops all observed input levels (Cook & Zhu, 2005; Thanassoulis, 2001).

Furthermore, the DEA model in equation (4.14) is an **input-orientated DEA model** since it seeks to maximise the proportional reduction in inputs whilst holding the current outputs constant. Equation (4.11), which is the dual form of equation (4.14), is referred to as ***multiplier*** or ***value-based* DEA model** (Cook & Zhu, 2005; Thanassoulis, 2001), which in this case has input orientation. Correspondingly, an envelopment DEA model can also be devised to maximise the increase in outputs whilst holding the current inputs constant, i.e. **output-orientated DEA model** (T. J. Coelli et al., 2005; Cook & Zhu, 2005; Thanassoulis, 2001), as the following:

$$\text{Max } \phi + \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \tag{4.15}$$

subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} + s_i^- = x_{i0} \qquad i = 1,2,\ldots,m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} - s_r^+ = \phi y_{r0} \qquad r = 1,2,\ldots,s$$

$$0 < \varepsilon << 1$$

$$\lambda_j \geq 0; \quad j = 1,2,\ldots,N$$

As previously, the use of infinitesimal non-Archimedean ε herein allows the two-stage linear programming calculation whereby the maximisation of ϕ is to be solved prior to the optimisation involving slack variables.

IV.5.2. Banker, Charnes, and Cooper (BCC) Model

Banker et al. (1984) modifies CCR model by applying a more realistic VRS assumption instead of CRS, whereby DMUs are recognised to have different returns to scale pertaining to their condition. CRS assumption is valid in condition where DMUs operate at optimal scale yet in reality it is hardly so. Thus, using CCR model to measure the technical efficiency may not be accurate if scale inefficiency exists (Banker et al., 1984; T. J. Coelli et al., 2005). The existence of scale inefficiency causes the difference between VRS technical efficiency of a DMU (pure technical efficiency) to its CRS technical efficiency.

In this model, Banker et al. (1984) added additional constraint of $\sum_{j=1}^{N} \lambda_j = 1$, which represents convexity constraint for λ_j to assure the VRS assumption. This additional constraint denotes convexity nature of the frontier, presents a new variable of μ_0 into the dual model, thus making returns to scale evaluation possible. This additional constraint also ensures that a DMU will only be compared to the similar-sized DMUs with the same return to scale, thus pure technical efficiency score from BCC model is equal to or greater than TE score from CCR model due to smaller number of DMUs it is compared to (Thanassoulis, 2001). BCC model is thus known as VRS model (Cooper et al., 2004).

The final form of **input-orientated BCC model** is the following:

$$\text{Min } \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \tag{4.16}$$

subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} + s_i^- = \theta x_{i0} \qquad i = 1,2,\ldots,m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} - s_r^+ = y_{r0} \qquad r = 1,2,\ldots,s$$

$$\sum_{j=1}^{N} \lambda_j = 1 \qquad j = 1,2,\ldots,N$$

$$0 < \varepsilon << 1$$

$$\lambda_j \geq 0$$

Whilst the **output-orientated BCC model** can be presented as follows:

$$\text{Max } \phi + \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \tag{4.17}$$

subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} + s_i^- = x_{i0} \qquad i = 1,2,...,m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} - s_r^+ = \phi y_{r0} \qquad r = 1,2,...,s$$

$$\sum_{j=1}^{N} \lambda_j = 1 \qquad j = 1,2,...,N$$

$$0 < \varepsilon << 1$$

$$\lambda_j \geq 0$$

From the formulation of BCC models in equation (4.16) and (4.17) above, it can be observed that the difference from CCR models in equation (4.14) and (4.15) is the additional constraint of $\sum_{j=1}^{N} \lambda_j = 1$ that makes local return to scale calculation possible.

In relation to this study, output-orientated BCC model is utilised in the first study efficiency comparison between Islamic and conventional microfinance in EAP, SA and MENA regions. This first study serves as a preliminary knowledge regarding the performance differences between these two microfinance method approaches. The detail of this first study and the model specification used will be presented in Chapter V. This is also manifest in the use of DEA in microfinance studies, some of which are highlighted at Table 4.1.

Table 4.1: DEA Application in Microfinance Studies

Author(s)	MFIs	Scope*	Period	RTS	Orientation**	Approach***	Inputs***	Outputs***	Key Findings
Nghiem, Coelli & Rao (2006)	46	Vietnam	2006	VRS	I	P	Labour costs Non-labour costs	Savers Borrowers Groups	MFI Age & distance to township affects MFI efficiency
Fluckiger and Vassiliev (2007)	39	Peru	2003	VRS	O	P	Employees Assets Operating expenses	Loans Net operating income	Average efficiency of 39 Peruvian MFIs in 2003 is 85.5%
Gutiérrez-Nieto et al. (2007)	30	Latin America	2001-2002	CRS	O	P and I	Credit officers Operating expenses	Gross loan portfolio Loan outstanding Interest & fee income	Country effect & NGO status affect efficiency scores (multivariate analysis)
Bassem (2008)	35	Medi-terranian	2004-2005	CRS VRS	I	P	Personnel Total Assets	Women borrowers ROA	Medium-sized MFIs are found to be more efficient
Gutiérrez-Nieto et al. (2009)	89	Global	2003	CRS	O	P	Assets Operating expenses Employees	Gross loan portfolio Women borrowers Index of benefit to poor Financial revenue	· To be socially efficient MFIs need to be financially efficient · Facing choices, MFIs will opt to be financially efficient · No relationship between social efficiency and age
Hassan & Sanchez (2009)	214 (in 2005) 45 (2001-5)	Latin America MENA SA	2001-2005	CRS VRS	I and O	P and I	Total financial expenses (I) Operating expenses (P & I) Labor (P & I)	Gross loan portfolio (I) Total funds (I) Financial revenue (I) Borrowers (P)	· Higher TE for formal MFIs · SA MFIs have higher TE than Latin America and MENA · Inefficiency source is pure TE · TE stagnant in 2001-5 period
Komlan & Sedzro (2009)	161 (in 2000) 210 (in 2001) 168 (in 2002)	WAEMU (West African Economic and Monetary Union)	2001-2002	CRS VRS	O	P and I	Labor (P & I) Physical capital (P & I) Financial capital (P) Total deposits (I)	Loans per year (I) Investments (P & I) Interest income (I) Borrowers (P) Savers (P)	Countries environment affect perfomance differences
Haq, Skully & Pathan(2010)	39	Africa Asia America	2004	CRS VRS	I and O	P and I	Labor (P & I) Operating expenses (I) Cost per borrower (P) Cost per saver (I)	Gross loan portfolio (I) Borrowers per staff (P) Savers per staff (P) Total savings (I)	· High level of cost efficiency fall due to NPL for Bank-MFI · NGO-MFIs are more efficient in P · Bank-MFIs are more efficient under I
Kipesha (2012)	35	East Africa	2009-2011	CRS VRS	I	P	Total assets Revenues Personnel	Gross loan portfolio Financial revenue	· TE differences between East African countries · Bank & NBFI have higher TE vs NGO & Credit Union
Widiarto & Emrouznejad (2015)	63 (EAP) 29 (MENA) 113 (SA)	EAP MENA SA	2009-2010	VRS CRS	O and I	P	Assets Operating expenses PAR 30 Employees	Financial Revenue Inverse of Average Loan Balance per GNI per capita Borrowers	· Trade-off between dual objectives can be managed & pursued concurrently · IMFIs & MFIs tie in overall efficiency yet MFIs excel in scale efficiency · MFIs mostly topped IMFIs in outreach & sustainability · Not-for-profit MFIs deliver higher outreach

*EAP= East Asia & the Pacific; MENA = Middle East and North Africa; SA = South Asia
**I = input-orientated and O = output-orientated
***P= production approach and I = intermediation approach

IV.6. Total Factor Productivity Growth

As discussed at Section III.3.4, the commonly-used average productivity ratio of one selected output over one selected input to measure productivity of a firm, e.g. output per labour hour, is conceptually inept; in a real life situation whereby a transformation involves multiple inputs – outputs, average productivity only a depicts partial fact. Moreover, inputs in transformation process are often contingent to each other, making this approach fail to assess the total factor productivity of a firm. To address this, a more thorough approach that integrates changes in all inputs and outputs needs to be constructed.

This section covers DEA-based measurement of total factor productivity growth ("TFPG") as more adept alternative of the method based on average productivity mentioned productivity growth analysis to above. This section focuses with the DEA-based Malmquist productivity index and its decomposition, starting with the CRS-based Malmquist Index from Färe, Grosskopf, Norris, and Zhang or known as FGNZ model (Färe et al., 1994), the VRS-based Ray and Desli modification model (Ray & Desli, 1997), and Circular Malmquist Index.

IV.6.1. Malmquist Productivity Index – FGNZ Model

Malmquist productivity index ("MI") is one of the commonly-used methods in the measurement of total productivity change over time in empirical studies, especially that which is based in nonparametric DEA methodology. It is introduced by Caves, Christensen, and Diewert in their two seminal works (Caves et al., 1982a, 1982b); in contrary to indices such as Tornqvist and Fisher productivity index which depicts a descriptive measure of productivity, it is a normative measure of productivity change assessment since it constructs a production frontier to which different distance function efficiencies with different input-output combinations are compared (Ray, 2004). Productivity change is measured by the extent to which a DMU has moved its location relative from time *0* to time *1*.

Caves, Christensen, and Diewert postulates MI from the perspective of output distance function as follow:

$$MI_0^o = \frac{D_0^o(x_1, y_1)}{D_0^o(x_0, y_0)} \tag{4.18}$$

If it is assumed that the frontier is static, $D_0^o(x_0, y_0)$ and $D_0^o(x_1, y_1)$ represent the output distance function of (x_0, y_0) and (x_1, y_1), respectively, relative to frontier at time *0*. In MI context, the output distance function is equivalent to the maximum radial outputs expansion of the assessed DMU holding inputs constant. Moreover, even though CCD model was postulated under output-orientated perspective, due to its CRS assumption CCD model equation (4.18) also holds for input distance function as output and input distance function herein yield the same result, i.e. discussed at length in Chapter III. Thus, hereinafter MI_0^o will be denoted as MI_0^{CRS}, as well as the other associated notations.

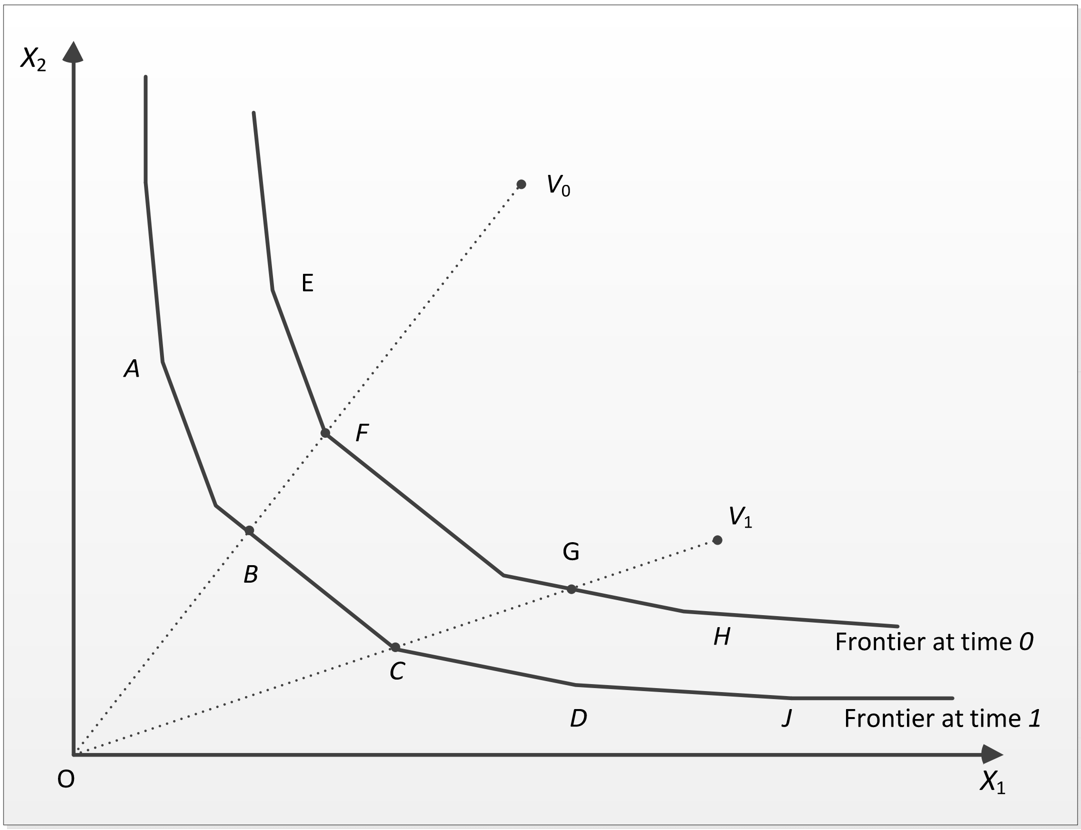
Efficiency change over time is illustrated in Figure 4.2, whereby V_0 represents the performance of assessed DMU V at time *0* whilst V_1 represents that of DMU V at time *1*. Frontier EFGH represents the frontier at time *0*. If the frontier is assumed to be static at EFGH from period *0* to period *1*, V_1 is closer to frontier relative to V_0 since $\frac{OG}{OV_1}$ is greater than $\frac{OF}{OV_0}$. Therefore, relative to static frontier EFGH productivity of $V_1$is greater than V_0. MI can be calculated in this situation as $\frac{OG}{OV_1} / \frac{OF}{OV_0}$, which is MI of DMU V relative to frontier at time *0*.

However, in reality the frontier which represents technology in industry level may also shift over time, representing the change in general *industry-level* technology. In Figure 4.2 this is illustrated by the shift of the frontier from EFGH to ABCD. If frontier also changed from time *0* to time *1*, then the equivalent MI can also be perceived relative to the frontier at time *1*, as follow:

$$MI_1^{CRS} = \frac{D_1^o(x_1, y_1)}{D_1^o(x_0, y_0)} \tag{4.19}$$

In the example shown at Figure 4.1, MI of DMU V relative to frontier ABCD, i.e. new frontier at time *1*, thus can be calculated as $\frac{OC}{OV_1} / \frac{OB}{OV_0}$.

Figure 4.1: Efficiency Change and Frontier Shift over time



Source: Thanassoulis (2001), redrawn and modified by author

Consequently, MI_0^{CRS} and MI_1^{CRS} from two equations above will yield different results as the output distance functions in time *0* and time *1* are calculated relative to the different frontiers. In this regard, Färe et al. (1992) offered a solution to this problem by reformulating MI as a geometric average to MI_0^{CRS} and MI_1^{CRS} instead of a priori selection of either frontier as basis for calculation, such that:

$$MI = \left(\frac{D_0^{CRS}(x_1, y_1)}{D_0^{CRS}(x_0, y_0)} \times \frac{D_1^{CRS}(x_1, y_1)}{D_1^{CRS}(x_0, y_0)} \right)^{\frac{1}{2}} \tag{4.20}$$

In equation (4.20) above, MI is now a geometric average of equiproportional measurement of DMU distances in period *0* and period *1* relative to the production frontier at period *0* and period *1*. Moreover, this reformulation enables the decomposition of the source of the productivity change: as frontier and efficiency can both change over time, it is then important to understand whether the productivity change measured is due to frontier shift, efficiency change, or both. The assumption technology for the equation above is CRS. Thus, Färe, Grosskopf, Norris, and Zhang ("FGNZ"), through algebraic manipulation, proposed one of the most prominent decompositions of MI – known as FGNZ model – in their 1994 seminal paper (Färe et al., 1994) as follows:

$$MI_{FGNZ} = \frac{D_1^{CRS}(x_1, y_1)}{D_0^{CRS}(x_0, y_0)} \times \left(\frac{D_0^{CRS}(x_1, y_1)}{D_1^{CRS}(x_1, y_1)} \times \frac{D_0^{CRS}(x_0, y_0)}{D_1^{CRS}(x_0, y_0)} \right)^{\frac{1}{2}} \tag{4.21}$$

The ratio in the first part of the equation (4.21), $\frac{D_1^{CRS}(x_1, y_1)}{D_0^{CRS}(x_0, y_0)}$, calculates the changes in TE of the assessed unit over time from time 0 to time 1 relative to its period's respective frontiers. This is referred to as ***catch-up*** component or ***efficiency change*** **("EC")**, so that:

$$EC = \frac{D_1^{CRS}(x_1, y_1)}{D_0^{CRS}(x_0, y_0)} \tag{4.22}$$

On the other hand, the geometric mean of two ratios inside the bracket at the second part of equation (4.21), $\left(\frac{D_0^{CRS}(x_1, y_1)}{D_1^{CRS}(x_1, y_1)} \times \frac{D_0^{CRS}(x_0, y_0)}{D_1^{CRS}(x_0, y_0)} \right)^{\frac{1}{2}}$, measures the shift in industry-level technology. It is referred to as ***boundary shift*** component or ***technological change*** **("TC")**. TC calculates geometric means of the distance caused by movement of the boundary from time 0 to time 1 to assessed DMU in two locations: $\frac{D_0^{CRS}(x_1, y_1)}{D_1^{CRS}(x_1, y_1)}$ computes the distance of DMU in time *1* to frontier time *0* relative to its distance to frontier at time *1*, whilst

$\dfrac{D_0^{CRS}(x_0, y_0)}{D_1^{CRS}(x_0, y_0)}$ computes the distance of DMU in time *0* to frontier time *0* relative to new frontier at time *1*. This can be written as follows:

$$TC = \left(\frac{D_0^{CRS}(x_1, y_1)}{D_1^{CRS}(x_1, y_1)} \times \frac{D_0^{CRS}(x_0, y_0)}{D_1^{CRS}(x_0, y_0)} \right)^{\frac{1}{2}} \tag{4.23}$$

Thus, the decomposition of MI in FGNZ model can be rewritten as follows:

$$MI_{FGNZ} = EC \times TC^{CRS} \tag{4.24}$$

In this decomposition, MI allows that productivity change to be calculated as a mixture of efficiency change *at the firm level* and technological change *at the industry level* (Thanassoulis, 2001). MI index greater than 1 indicates that there is an improvement in productivity level, whilst MI index smaller than 1 shows that there is a decline in productivity level.

Referring to the illustration at Figure 4.1, the MI_{FGNZ} can be calculated by multiplying the *EC* of $\frac{OC}{OV_1} / \frac{OF}{OV_0}$, which represents the firm-level efficiency change of TE time *1* relative to TE time *0*, to the TC^{CRS}, i.e. the geometric means of MI_0^{CRS} and MI_1^{CRS} which is calculated as $\left(\frac{\frac{OG}{OV_1}}{\frac{OC}{OV_1}} \times \frac{\frac{OF}{OV_0}}{\frac{OB}{OV_0}} \right)^{\frac{1}{2}}$. This TC^{CRS} represents the industry-level technological change from frontier EFGH to frontier ABCD.

Since the MI formula above is calculated relative to the conical CRS boundary/frontier, it will yield the same measure for both output- and input-orientated approach. FGNZ thus referred to the distance function measured relative to CRS frontier as *benchmark* distance, whereby the assessed DMU is operating at its MPSS. In reality, many DMUs are still not operating at their MPSS hence convex VRS frontier is more preferable as benchmark (Giraleas, 2013). Yet, the MI above can still be applied to that purpose; FGNZ model offered that the CRS frontier can be used as *benchmark* frontier in productivity measurement for assessed DMU under VRS as its efficiency change over time and its convex VRS frontier movement over time can be measured relative to its MPSS, i.e. whether the DMU and its frontier are moving toward or further from MPSS. Accordingly, FGNZ model postulated an alternative decomposition of the MI above on the part of EC under CRS assumption, i.e. first part of the equation (4.21) and (4.24), so that the MI formula can be rewritten as follow:

$$MI_{FGNZ}^{VRS} = \frac{D_1^{VRS}(x_1, y_1)}{D_0^{VRS}(x_0, y_0)} \times \frac{S_1(x_1, y_1)}{S_0(x_0, y_0)} \times \left(\frac{D_0^{CRS}(x_1, y_1)}{D_1^{CRS}(x_1, y_1)} \times \frac{D_0^{CRS}(x_0, y_0)}{D_1^{CRS}(x_0, y_0)} \right)^{\frac{1}{2}} \tag{4.25}$$

$$MI_{FGNZ}^{VRS} = PEC \times SC_{FGNZ} \times TC^{CRS}$$

In the equation (4.25) above, the EC part in equation (4.21) is decomposed into two parts: ***pure efficiency change* ("PEC")** and ***scale efficiency change* ("SC")**, since $TE^{CRS} = TE^{VRS} x\, SE$ as in equation (3.14) previously in Chapter III. PEC herein represents the change in efficiency under VRS, i.e. TE^{VRS} of the assessed DMU in time *1* relative to frontier in time *1* compared to TE^{VRS} of the assessed DMU in time *0* relative to its frontier in time *0*. $D_1^{VRS}(x_1, y_1)$ and $D_0^{VRS}(x_0, y_0)$ herein represents TE_1^{VRS} and TE_0^{VRS}, respectively. Thus:

$$PEC = \frac{D_1^{VRS}(x_1, y_1)}{D_0^{VRS}(x_0, y_0)} \tag{4.26}$$

On the other hand, SEC portrays the change in scale efficiency over time, i.e. the scale efficiency of the assessed DMU in time *1* relative to that in time *0*. $S_1(x_1, y_1)$ and $S_0(x_0, y_0)$ herein represents SE_1 and SE_0, respectively, so that:

$$SC_{FGNZ} = \frac{S_1(x_1, y_1)}{S_0(x_0, y_0)} \tag{4.27}$$

IV.6.2. Malmquist Productivity Index – RD Model

Ray & Desli (1997) criticised the decomposition of FGNZ model to accommodate the productivity measurement of DMU under VRS condition in equation (4.25) above as being internally inconsistent, even though being theoretically correct. This is due to the fact that the TC component is still accounts for the CRS frontier movement whilst the PEC and SEC account for movement in efficiency under VRS frontier and scale efficiency. This model left out the movement of VRS frontier which is more important for the DMUs operating in VRS technology. Thus, they proposed an alternate MI decomposition in amend the FGNZ model as follows:

$$MI_{RD} = \frac{D_1^{VRS}(x_1, y_1)}{D_0^{VRS}(x_0, y_0)} \times \left(\frac{D_0^{VRS}(x_1, y_1)}{D_1^{VRS}(x_1, y_1)} \times \frac{D_0^{VRS}(x_0, y_0)}{D_1^{VRS}(x_0, y_0)} \right)^{\frac{1}{2}} \times \left(\frac{S_0(x_1, y_1)}{S_0(x_0, y_0)} \times \frac{S_1(x_1, y_1)}{S_1(x_0, y_0)} \right)^{\frac{1}{2}} \quad (4.28)$$

$$MI_{RD} = PEC \times TC^{VRS} \times SC_{RD}$$

whereby:

$$TC^{VRS} = \left(\frac{D_0^{VRS}(x_1, y_1)}{D_1^{VRS}(x_1, y_1)} \times \frac{D_0^{VRS}(x_0, y_0)}{D_1^{VRS}(x_0, y_0)} \right)^{\frac{1}{2}}$$

$$SC_{RD} = \left(\frac{S_0(x_1, y_1)}{S_0(x_0, y_0)} \times \frac{S_1(x_1, y_1)}{S_1(x_0, y_0)} \right)^{\frac{1}{2}} \quad (4.29)$$

In alternative MI decomposition offered in equation (4.28) above, Ray and Desli (1997) also decomposed the CRS technological change (TC^{CRS}) into VRS technological change (TC^{VRS}) and scale efficiency change for TC, as opposed to only decomposing EC as in FGNZ. The final form is that both efficiency change and technological change components are assessed relative to VRS technology. In addition to that the scale efficiency change is now a geometric mean of scale efficiency change relative to time *0* and scale efficiency change relative to time *1*.

However, there is a caveat with this model, i.e. it requires cross-period distance function for both technological change and scale efficiency change; this may be problematic if the not all input – output combinations from DMUs observed in one period can be fully enveloped by frontier in other period. This may cause infeasible solution to some of the DMUs under assessment in DEA model thus renders the decomposition for these DMUs unattainable. Consequently, the application of this model may not be easy despite being theoretically correct and internally consistent (Giraleas, 2013)

IV.6.3. Circular Malmquist Index

From both the Malmquist Index from FGNZ model and its VRS modification from RD model, it can be observed that there are several main issues with the conventional Malmquist model that are important to note. These main issues, derived from summary by Giraleas (2013) and Kerstens and Van de Woestyne (2014), are as follow:

1. **The ambiguous nature of treatment regarding the measurement and decomposition of the boundary/technological shift and scale efficiency component in the Malmquist Index.**

   The technological shift offered by FGNZ model for measurement of DMUs operating on VRS technology is viewed as internally inconsistent since it measures the shift only in CRS frontiers over time but not in the VRS frontiers which are more relevant to the DMUs under analysis.

   On the other hand, the MI decomposition offered by RD model for VRS environment, which further decomposes the CRS technological shift into VRS TC and its corresponding scale efficiency change thus subsequently offers a new calculation of scale efficiency change, is theoretically correct and internally consistent but difficult to apply due to cross-frontier references in both TC^{VRS} and SEC_{RD} may result in unfeasible solution in at least some DMUs under analysis.

2. **Dealing with unbalanced data.**

   One recurring issue in conventional Malmquist Index is how to deal with unbalanced panel data. This issue is important since not all panel databases are perfectly balanced; many panel databases, either from primary or secondary sources, have missing observation in some of the DMUs for some of periods observed. The global MFI database compiled by MIX is one of the examples of the unbalanced database due to its voluntary data submission nature. In fact, the nature of database in microfinance sector is regrettably unbalanced, due to the fact that not all MFIs are regulated by the central bank in its country of operation thus not required to submit any performance data.

In dealing with unbalanced data in conventional Malmquist Index, there are still wide spectrums of opinions amongst scholars in its treatment. Some scholars suggest that balanced panel data is a prerequisite for Malmquist Index, e.g. Hollingsworth and Wildman (2003), hence measures need to be undertaken to convert an unbalanced dataset into somehow a balanced dataset. Kerstens and Van de Woestyne (2014) provided a summary of different techniques used in the literatures to date in 'balancing the unbalanced'. On the contrary, other scholars including Färe, Grosskopf, Norris, and Zhang argued that the use of unbalanced panel is possible in Malmquist Index calculation albeit "the index will be undefined for missing observations" (Färe et al., 1994, p. 73 Fn 14). It will not lead to infeasible solution as in RD decomposition (Giraleas, 2013).

Nevertheless, this is still a glitch in the regular Malmquist Index application. Indeed, in MI analysis, the observations on both the base and end periods are crucial, i.e. the absence of either one will annul the calculation. Moreover, Kerstens and Van de Woestyne (2014), whilst observing many 'balancing the unbalanced panel' techniques as pseudo-solutions, found that vetting out the unbalanced panel into balanced panel could yield a substantial loss of information and the difference in end result may be significant depending on the nature of the dataset. Thus, more permanent solution needs to be undertaken for unbalanced panel data in this regard.

3. **Volatility in MI estimates due to entry or exit of DMUs into the analysis.**

The vague treatment of unbalanced data in MI is emblematic of a larger problem: volatility in the MI estimates. One consequence of the unbalanced panel data is that there are observations that are either 'exiting' or 'entering' the dataset in the periods observed, e.g. in a twenty-year annual observation, a DMU *A* may have observation for the first ten years, then missing for three years, and subsequently observed again in the last seven years. Another usual case was that a DMU may have intermittent observations along the periods observed. If the missing DMU is the reference for other

DMUs in a preceding period and there is no other DMUs with similar input – output combination to replace it as reference, then the resulting frontier in this particular period will be much different.

4. **Non-circularity nature of the regular MI.**

   Since the calculation of regular MI is based on the distance functions in base and end periods which are measured relative to different frontiers, the resulting index is non-circular. This means that the MI formulation may not derive the productivity change between year 1 and year 5 even if the productivity changes between year 1 – year 2, year 2 – year 3, year 3 – year 4, and year 4 – year 5 are calculated. Although some scholars argued that circularity is not an essential feature for a productivity index[4], a circularity nature is nonetheless a desirable feature thus alternative method that can show this feature is advantageous for productivity growth calculation.

In this regard, a DEA-based circular Malmquist Index can be presented as alternative to tackle the abovementioned issues. This approach is based on the idea of indirect distance function measurement whereby all observations from different periods in dataset are to be assessed relative to a common meta-frontier, as opposed to the conventional Malmquist Index which measured the distance function of these observations relative to different frontiers for comparison. This meta-frontier envelops multi-year observations in one production set, enabling these observations to be directly compared and, most importantly, to have circularity nature. This circular Malmquist Index is introduced by Pastor and Lovell (2005) and developed further in its decomposition by Portela and Thanassoulis (2008).

The assumption that allows this meta-frontier to be constructed is that convexity holds for all data points across all time periods in the dataset, leading to more general assumption that a feasible technology in base period will stay as feasible in the future period. Even though it is a restrictive assumption considering possible environmental changes that may render one technology infeasible in the future, Giraleas (2013) noted that the significance of this restriction is still ambiguous, recalling that amongst two

[4] An example of this is Färe & Grosskopf (1996)

frontiers under assessment in regular Malmquist Index there may include one infeasible technology.

In this approach, the relationship of efficiency of DMU_j relative to its actual technological frontier T at time t, to its efficiency relative to the meta-frontier m constructed from multi-year observations which can be written as per notational from Portela and Thanassoulis (2008) and Tohidi et al. (2012) with slight modification, as follows:

$$\theta_{jt}^{m} = \theta_{jt}^{T} \times TG_{jt} \tag{4.30}$$

In the equation (4.30) above, θ_{jt}^{m} represents efficiency of DMU_j at time t relative to meta-frontier m (which is solved through DEA incorporating all DMU observations from all periods), whilst θ_{jt}^{T} signifies efficiency of DMU_j at time t relative to its actual technological frontier T. The last component TG_{jt} denotes technological gap between frontier T at time t to meta-frontier m, i.e. the distance between frontier T at time t to meta-frontier m. Therefore, TG_{jt} can be residually calculated as follows:

$$TG_{jt} = \frac{\theta_{jt}^{m}}{\theta_{jt}^{T}} \tag{4.31}$$

Specifically, technological gap TG_{jt} in this approach is calculated as efficiency of DMU_j against meta-frontier m, termed as ***meta-efficiency*** of DMU_j, relative to its efficiency against its technological frontier T.

The common meta-frontier enveloping all observations from all periods in the dataset makes all observations directly comparable; thus, the productivity change of DMU_j from time t to time $t+1$ can be measured by the ratio of its meta-efficiencies in these two periods as follows:

$$MI_C = \frac{\theta_{jt+1}^{m}}{\theta_{jt}^{m}} \tag{4.32}$$

which is termed as Circular Malmquist Index (CMI) and notated as MI_C with subscript c signifies the circular model, as opposed to the regular Malmquist Index models. Consequently, integrating equation (4.30) into Circular Malmquist Index MI_C in equation (4.32) will yield CMI decomposition as follows:

$$\begin{aligned} MI_C &= \frac{\theta_{jt+1}^T}{\theta_{jt}^T} \times \frac{TG_{jt+1}}{TG_{jt}} \\ MI_C &= EC_C \times TGC \end{aligned} \tag{4.33}$$

In the decomposition of CMI in the equation (4.33) above, the first component $\frac{\theta_{jt+1}^T}{\theta_{jt}^T}$ calculates the efficiency change from that at frontier *t+1* relative to that at frontier *t*, i.e. the **efficiency change** component (EC_C) similar to that in conventional Malmquist Index. The second component of the equation, $\frac{TG_{jt+1}}{TG_{jt}}$, encapsulates the distance of frontier *t+1* to the meta-frontier *m* relative to the frontier *t* to the same meta-frontier *m*, i.e. the movement of frontier *t+1* to the meta-frontier compared to frontier *t*. Therefore, the second component represents the **technological shift** component, termed as **technological gap change** (*TGC*).

This decomposition is analogous to the decomposition of Malmquist Index from FGNZ model in equation (4.24). Yet, the distinctive part regarding the boundary/technological shift herein is that it is no longer a geometric means of the ratio of DMU_j distance in time *t+1* from frontier *t+1* relative to that in frontier *t* with the ratio of DMU_j distance in time *t* from frontier *t+1* relative to that in frontier *t*; instead, the *TGC* is now a direct ratio between the distance of frontier *t+1* and frontier *t* relative to the meta-frontier *m*. This is because the meta-frontier *m* now envelops all data from all periods (and the frontiers constructed from them) so that these different frontiers are directly comparable. Consequently, the TC calculation from traditional MI may yield different result from *TGC* of CMI, hence the source of result differences between MI and CMI.

The Circular Malmquist Index presented in equation (4.33) assumes hitherto a CRS technology. Portela and Thanassoulis (2008) modified this model by dropping the CRS assumption for VRS thus presented a further decomposition of the Circular Malmquist Index to derive a pure efficiency change (PEC_C) and TGC estimates which are bias-free from scale economies size akin to that in RD model. The following decomposition starts from CMI formulation under CRS assumption as presented in equation (4.33).

$$MI_C = \frac{\theta_{jt+1}^{T}}{\theta_{jt}^{T}} \times \frac{TG_{jt+1}}{TG_{jt}}$$

$$MI_C^{CRS} = \frac{\theta_{jt+1}^{T(CRS)}}{\theta_{jt}^{T(CRS)}} \times \frac{\left(\dfrac{\theta_{jt+1}^{m(CRS)}}{\theta_{jt+1}^{T(CRS)}}\right)}{\left(\dfrac{\theta_{jt}^{m(CRS)}}{\theta_{jt}^{T(CRS)}}\right)}$$

The components specified under CRS above then were presented in their VRS pure efficiencies by disentangling them from their scale efficiencies as follow:

$$MI_C^{CRS} = \frac{\theta_{jt+1}^{T(VRS)}}{\theta_{jt}^{T(VRS)}} \times \frac{\left(\dfrac{\theta_{jt+1}^{m(VRS)}}{\theta_{jt+1}^{T(VRS)}}\right)}{\left(\dfrac{\theta_{jt}^{m(VRS)}}{\theta_{jt}^{T(VRS)}}\right)} \times \frac{SE_{jt+1}^{T}}{SE_{jt}^{T}} \times \frac{\left(\dfrac{SE_{jt+1}^{m}}{SE_{jt+1}^{T}}\right)}{\left(\dfrac{SE_{jt}^{m}}{SE_{jt}^{T}}\right)}$$

$$MI_C^{CRS} = \frac{\theta_{jt+1}^{T(VRS)}}{\theta_{jt}^{T(VRS)}} \times \frac{\left(\dfrac{\theta_{jt+1}^{m(VRS)}}{\theta_{jt+1}^{T(VRS)}}\right)}{\left(\dfrac{\theta_{jt}^{m(VRS)}}{\theta_{jt}^{T(VRS)}}\right)} \times \frac{\left(\dfrac{\theta_{jt+1}^{T(CRS)}}{\theta_{jt+1}^{T(VRS)}}\right)}{\left(\dfrac{\theta_{jt}^{T(CRS)}}{\theta_{jt}^{T(VRS)}}\right)} \times \frac{\left(\left(\dfrac{\theta_{jt+1}^{m(CRS)}}{\theta_{jt+1}^{m(VRS)}}\right) \bigg/ \left(\dfrac{\theta_{jt+1}^{T(CRS)}}{\theta_{jt+1}^{T(VRS)}}\right)\right)}{\left(\left(\dfrac{\theta_{jt}^{m(CRS)}}{\theta_{jt}^{m(VRS)}}\right) \bigg/ \left(\dfrac{\theta_{jt}^{T(CRS)}}{\theta_{jt}^{T(VRS)}}\right)\right)}$$

$$MI_C^{CRS} = \frac{\theta_{jt+1}^{T(VRS)}}{\theta_{jt}^{T(VRS)}} \times \frac{\left(\dfrac{\theta_{jt+1}^{m(VRS)}}{\theta_{jt+1}^{T(VRS)}}\right)}{\left(\dfrac{\theta_{jt}^{m(VRS)}}{\theta_{jt}^{T(VRS)}}\right)} \times \frac{\left(\dfrac{\theta_{jt+1}^{m(CRS)}}{\theta_{jt+1}^{m(VRS)}}\right)}{\left(\dfrac{\theta_{jt}^{m(CRS)}}{\theta_{jt}^{m(VRS)}}\right)}$$

$$MI_C^{VRS} = \frac{\theta_{jt+1}^{T(VRS)}}{\theta_{jt}^{T(VRS)}} \times \frac{TGV_{jt+1}}{TGV_{jt}} \times \frac{MSE_{jt+1}}{MSE_{jt}}$$

$$MI_C^{VRS} = PEC_C \times TGC^{VRS} \times MSC \tag{4.34}$$

in which:

$$TGV_{jt} = \frac{\theta_{jt}^{m(VRS)}}{\theta_{jt}^{T(VRS)}} \tag{4.35}$$

$$MSE_{jt} = \frac{\theta_{jt}^{m(CRS)}}{\theta_{jt}^{m(VRS)}} \tag{4.36}$$

The final decomposition in equation (4.34) is thus analogous to decomposition made by Ray and Desli (1997) in their RD model of MI as presented previously in equation (4.32) which also applies VRS as technology reference. The Circular Malmquist Index under VRS MI_C^{VRS} herein is decomposed into three components: the first component $\frac{\theta_{jt+1}^{T(VRS)}}{\theta_{jt}^{T(VRS)}}$ showing the within-period pure efficiency change $\mathrm{PEC_C}$, whilst the second component $\frac{TGV_{jt+1}}{TGV_{jt}}$ denotes the technological gap change or frontier shift from period *t* to period *t+1* (TGC^{VRS}), with breakdown of technological gap under VRS (*TGV*) calculation stated in equation (4.35). The last component, $\frac{MSE_{jt+1}}{MSE_{jt}}$, represents the meta-scale efficiency (*MSE*) change from meta-frontier in period *t+1* relative to that in period *t*. MSE_{jt} itself encapsulates the distance between the CRS and VRS meta-frontiers of DMU_j in period *t* (Tohidi et al., 2012), as denoted in equation (4.36). The change in *MSE* in this formulation is notated as meta-scale efficiency change (*MSC*).

The utilisation of meta-frontier as reference in Circular Malmquist Index makes it possible for unbalanced panel data to be used in productivity analysis sans the volatility issues. It also circumvents the use of cross-period efficiencies for VRS environment as in the RD model, which can be the budding source of infeasible DEA solutions in the RD model. Moreover, the use of meta-frontier makes it possible for the Malmquist Index to show circularity features.

IV.7. Malmquist Productivity Index Applied in This Study

Given the advantage of Circular Malmquist Index in productivity analysis involving unbalanced panel data, this study will use the Circular Malmquist Index in its final part of measuring productivity of Microfinance Institutions in six global regions. As previously mentioned, the character of MFI database from MIX is unbalanced due to its voluntary submission nature. Another reason is also the nature of the industry itself which has not been completely regulated as their financial institution counterparts such as banking, insurance and capital market sectors. Moreover, the MFIs in the dataset are of different sizes thus the use of VRS assumption is more appropriate herein as the effect of scale efficiency is likely. In addition to that, the circularity property in CMI has advantages in microfinance context due to its unbalanced data should annual production growth needed to be observed. All these reasons prompt the application of Circular Malmquist Index, especially the VRS model from Portela and Thanassoulis (2008) in the final productivity analysis that is covered in Chapter VII.

IV.8. Summary and Discussion

In this chapter different approaches to efficiency measurement and DEA-based productivity analysis had been examined. In regard to the efficiency measurement, it argues that appropriate approach for the microfinance research is the modern frontier approach vis-à-vis financial ratio approach due to its ability to impartially assesses MFI efficiency and due to its view of efficiency as relative measure rather than absolute corresponding to the efficiency definition, i.e. MFI performance is benchmarked against other MFIs in the dataset so that perception of trade-off between MFI dual objectives can actually be circumvented since there will be MFIs that can excel in both objectives *relatively*. From the efficiency perspective, the MFI dual objectives thus can be perceived as a problem of social and financial efficiency.

Amongst the modern frontier approaches, it is argued that the appropriate method in efficiency assessment in the context of microfinance study herein is the non-parametric DEA methodology due to its relative advantage compared to the parametric methods, i.e. in regard to its ability to undertake straightforward evaluation of transformation process involving multiple inputs and multiple outputs without the need for a priori assumption on production function, which will be beneficial to be proposed widely to MFIs as adept benchmarking method due to its relative simplicity. Due to the generally unbalance nature of microfinance dataset, this research also proposes the use of Circular Malmquist Index in productivity measurement in the final part of this study, especially the VRS-based Circular Malmquist Index from Portela and Thanassoulis (2008).

Chapter V: Efficiency of Islamic versus Conventional Microfinance

V.1. Study Background

This chapter presents the first out of three interconnected studies presented in this research in regards to microfinance efficiency. Its objective is to shed light on the performance comparison between Islamic and conventional microfinance. Due to the fact that conventional microfinance charges interest on loans, Islamic microfinance had been presented as alternative to cater to the poor who adhere to the Islamic faith-based commandment prohibiting interest-bearing loans. Moreover, as discussed in Chapter II, this concept was also originally developed as alternative to address embedded weaknesses in conventional microfinance implementation, especially in the perceived excessively high interest rates charged to customer and all the implications and excesses that come with it. There are many criticisms targeted toward the conventional microfinance practice in regard to the excessive interest rates that in many cases are higher than traditional banking institutions, details of which have been discussed in Section II.3.4.

Nevertheless, whilst IMFIs have started to play instrumental part in Muslim-majority regions in Asia, Africa, Central Europe and Middle East and North Africa (Karim et al., 2008; Obaidullah & Khan, 2008; Parveen, 2009), there are still very scant, if any, comprehensive empirical study assessing its actual performance related to dual objectives, let alone the comprehensive one involving total factor productivity measurement. Given Islamic microfinance potential in reaching out to the poor who would otherwise be left out or back away from conventional microfinance scheme, comprehensive empirical study is dreadfully needed to assess IMFI performance vis-à-vis double bottom objectives and to compare them against their conventional MFI counterparts, i.e. to assess its viability as alternative in poverty alleviation to gain wider support from governments and donors. The latter is crucial as studies had shown that the growth of Islamic microfinance are often hindered by unconducive local regulation (UN-HABITAT, 2005) and insufficient funding due to fewer donor/grant agencies that are available to back up its growth (Jones & Juul Petersen, 2011; Juul Petersen, 2012).

The rest of this chapter is arranged as follow: Section V.2 of this chapter presents the research questions and aims in this study. Thereafter, the efficiency specifications proposed in this study, the DEA model in first and second stage analysis, and thorough description of DEA input – output specification are described in Section V.3. The dataset used in this study are 231 MFIs and IMFIs in three regions in balanced panel data in 2009-2010 period, to observe how IMFIs fare with MFIs and specific factors that may contribute to their efficiencies, which is described in Section V.4. Subsequent Section V.5 and Section V.6 present the result of first stage and second stage analysis, respectively; Section V.7 closes this chapter with the conclusions and discussion of the results. The concise form of this study in this chapter is published as Widiarto & Emrouznejad (2015).

V.2. Research Questions and Research Aims

There are three main questions explored in the study presented in this chapter; firstly, this study intends to map the performance of MFIs in regions analysed based on the three efficiency specifications stated above, i.e. social, financial, and overall efficiency, in the period observed. This is to provide the basic understanding of the MFIs performance in regard to dual bottom objectives and also to assess whether the three efficiency specifications above are proficient as performance indicator that provide vital insights on MFI performance. In this regard, this study proposes the social-financial efficiency matrix to map out MFIs performance in these objectives that serve as vital supplement to overall performance captured in overall efficiency measure. This matrix is aimed to simplify MFI stakeholders to observe MFI performance and to pursue performance improvement in the future.

Secondly, this study explores whether there are significant differences in performance between Islamic microfinance institutions and their conventional counterparts in the region observed, i.e. in terms of overall, social, and financial efficiency. By this question, this study attempts to provide an empirical evidence of significant performance differences (or lack thereof) between these two main microfinance schemes. It aimed to contribute to quantitative performance literatures on Islamic microfinance which had been hitherto lacking, let alone in comparison to the conventional.

Moreover, it seeks to specifically observe whether Islamic microfinance can significantly outperform conventional microfinance in the efficiency criteria measured. This is argued to be important since one of the objectives of Islamic microfinance scheme was established is to offer better scheme to rectify weaknesses in conventional microfinance practice discussed in Section II.3.4. Thus, with principal amendments to conventional microfinance system presented in Section II.4.2, Islamic microfinance should theoretically show better performance than its conventional counterpart, especially in regard to social efficiency. The abolishment of high interest such as that in conventional microfinance should theoretically improve MFI social efficiency. However, there had been no empirical studies yet to support this claim.

Thirdly, this study investigates the question of whether factors such as MFI age, profit orientation, operational scale, customer targeting, and MFI regulatory status have significant influence to efficiency of MFIs in the region observed. Moreover, this study observes whether there are regional differences significantly affect MFIs efficiency from global perspective. The analysis in this regard is intended to contribute to the existing literatures in regard to effect of these factors yet from the perspective of DEA.

V.3. Efficiency Criteria, DEA Model and Input-Output Specifications

V.3.1. Proposed Efficiency Specifications for MFI Performance

This study utilises DEA methodology in measuring IMFIs performance in comparison to conventional MFIs. As per previous discussion at Sections I.1.4, II.3.2, and III.4, MFI performance is defined herein as how MFI accomplish for its double bottom objective of outreach to the poor and financial sustainability. From efficiency perspective, it is MFI's efficiency in its double bottom line objectives, i.e. in terms of social efficiency (i.e. representing its social mission of outreach to the poor) and financial efficiency (i.e.

representing its strive for financial sustainability in order to stay in business for long term). Another performance indicator introduced in this study is overall efficiency, which will measure how MFI optimises its inputs to achieve all its objectives. Thus, it is a criterion representing the overarching efficiency of MFI in achieving both social and financial efficiencies.

The primary performance criterion proposed for microfinance will thus be overall efficiency, with social and financial efficiency as crucial elements to complement the picture, i.e. in providing vital information on MFI performance in each of the double bottom objectives. This is in line with the third approach discussed in Section II.3.2.4 which argues that the perceived trade-off between social and financial objective can be bridged by setting an appropriate strategy for MFI. The proposed advantage of these criteria is a double-edged one; an overall performance of MFI that encompasses its social and financial missions is portrayed through overall efficiency, yet this result will be further broken down into its separate performance vis-à-vis outreach and financial sustainability. An MFI could, for example, show strong overall efficiency, yet lacking in social efficiency (outreach). Thus, by measuring these three measures of efficiency a more comprehensive picture of MFI performance can be achieved hence make improvement possible. Particularly, since in DEA every MFI will be assigned benchmark peers whose performance can be emulated in boosting its performance.

V.3.2. Methodology and Assessment Approach

V.3.2.1. Methodology in First and Second Stage Analysis

This study applies both output-orientated and input-orientated CCR and BCC DEA models in the first stage analysis. Output-orientated model is utilised because microfinance units naturally strive to maximise outputs, i.e. the dual bottom 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 as comparison to efficiency at MPSS and to calculate scale efficiency. This DEA models will be employed at the first stage of this study. As mentioned in previous section, this study proposes the social – financial efficiency matrix as an adept tool in mapping MFI performance against its dual objective. This matrix will be introduced and utilised in the first stage analysis.

The post DEA analysis at the second stage scrutinises the statistical significance of performance differences that may be observed in mean efficiency scores in the first stage, i.e. whether different scheme of IMFIs and MFIs significantly affect differences in MFI efficiency in the dataset. Moreover, it observes 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 short two-year period covered in the study, i.e. Kruskal-Wallis *H*-test and Jonckheere-Terpstra test. Kruskal-Wallis *H*-test is used to analyse significant influence of aforementioned factors to MFIs performance differences. As Kruskal-Wallis can only test statistical significance of differences but not the *direction* of these differences, Jonckheere-Terpstra test is thereafter executed 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):

$$r = \frac{z - \text{score}}{\sqrt{N}} \tag{5.1}$$

where *z*-score is standardised *J*-statistic from Jonckheere-Terspstra test, and *r* is only meaningful to be calculated if observed *J*-statistic from Jonckheere-Terspstra test is significant. Effect size *r* offers an objective measure of the importance of an effect. The magnitude of *r* is explained using benchmark in Cohen (1988): $r < 0.30$ is considered as small effect, $0.30 \leq r < 0.5$ is medium effect, whilst $r \geq 0.5$ is deemed as large effect. The sign for *r* shows the direction of the effect; positive *r* shows increasing trend from rank 1 to rank 2 and so forth, whilst negative *r* shows the reverse trend.

It is argued herein that 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. The factors, of which relationship to efficiency are to be analysed, are thus arranged as ranked order to enable the use of this test. For example, in calculating the relationship between MFI efficiency and MFI schemes, the two MFI schemes are ranked as 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 in ranked order from stricter to more flexible MFI scheme.

V.3.2.2. Assessment Approach

As per discussion in Section IV.3, this study uses production approach in measuring MFI performance. This approach will also be used in the subsequent second and third studies that are presented in Chapter VI and VII respectively. This approach is selected based on the fact that many MFIs in the database are not or are not authorised to collect deposits from the clients. Moreover, many that do so only collect mandatory deposit as a safety net for the client to cover the loan repayment should an unforeseeable condition happen that can lead to loan arrears. Consequently, to preserve homogeneity between all the MFIs, client deposit will not be used as input in DEA. However, it will be observed as additional environmental factor in the second stage analysis in the second study, i.e. to observe whether there is significant correlation between deposit and efficiency as a basis for policy recommendation.

V.3.3. DEA Input – Output Selection and Model Specifications

V.3.3.1. DEA Input-Output Selection

From literature review, DEA part in this study utilises four inputs to represent capital, labour and risk and three outputs, i.e. two inputs represent outreach (social objective) and one output represent sustainability (financial objective) listed below. The initial in brackets after the name of each variable will be used to identify the particular variable in DEA model specifications later in next section. The summary of these input and output selection is presented in Table 5.1.

Inputs used in this study:

- **Assets (A)**

  This represents assets needed for transformation process. This is used in Berger and Humphrey (1997), Bassem (2008), Kipesha (2012) and Gutiérrez-Nieto et al. (2009).

- **Operating Expense (O)**

  Included herein are all expenses related to operations, e.g. all personnel expenses, depreciation and amortization, and administrative expenses. This variable is used in banking and MFIs studies such as Berger and Humphrey (1997), Athanassopoulos (1997), Gutiérrez-Nieto et al. (2007), Gutiérrez-Nieto et al. (2009), and Hassan and Sanchez (2009).

- **Portfolio at Risk 30 Days (R)**

  Portfolio at Risk 30 days (PAR 30) shows the percentage of total loan outstanding is at risk of default by having one or two or more principal or instalments past due more than 30 days. As far as it uses in literature, this variable has not been hitherto used in other microfinance studies utilising DEA methodology, yet it is argued to be important in the MFI performance measurement herein as it is a variable represents risk in operation and serves as warning sign of future delinquency problem, as per Rosenberg (2009).

- **Employees (E)**

  This variable is widely utilised in Athanassopoulos (1997), Berger and Humphrey (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Haq et al. (2010), and Kipesha (2012) to represents labour input for transformation process. As in these studies, it uses definition given by MIX that represents all individuals employed by MFI, including contract employees or advisor even if they are not listed on MFI roster of employees.

Output variables:

- **Financial Revenue (R)**

  As in Gutiérrez-Nieto et al. (2009), and Hassan and Sanchez (2009), this variable represents revenues from loan portfolio and other financial asset representing output in production approach to measures ***sustainability***. This variable is chosen over interest revenue variable that relates directly to income from loan portfolio because some MFIs also have fee-based income from other activities or other financial assets outside of loan portfolio.

- **Inverse of Average Loan Balance standardised over GNI per Capita (I)**

  Average loan balance standardised over GNI per capita is a variable that has been widely used in literatures as proxy to represent ***outreach***, more specifically *the depth of outreach*. The smaller the average loan per MFI borrowers means that a particular MFI has penetrated deeper toward the poorest of the poor community as the poorest segment usually demand small-sized loan, thus the smaller loan the better its penetration. This variable is standardised over GNI per capita to remove currency value and purchasing power differences between countries, as loan in nominal value may have different value in different countries or even different regions in one country. For example a loan of GBP 200 may not look significant in the UK but it is considered a relatively large loan in Indonesia. The standardisation presents average loan balance in the form of percentage of GNI per capita as opposed to nominal value, thus makes the average loan balance comparable between different countries.

  In its use as output in DEA models herein, this variable is used in its inverse format so as to have output characteristic where the larger value is the better. This is a modification from existing literature, as Gutiérrez-Nieto et al. (2009) used this variable along with number of borrowers as an index of the benefit to the poor yet this study chooses to keep these two variables separately so that target for DMU to increase its efficiency can be calculated clearly and to avoid problem associating to the use of index as DEA input/output (Emrouznejad & Amin, 2009).

Table 5.1: DEA Input-Output Variables

Inputs	Initial	Definition	Usage in literatures	Unit
Assets	A	Asset needed in transformation process	Berger and Humphrey (1997), Bassem (2008), Kipesha (2012) and Gutierrez-Nieto et al. (2009)	USD '000
Operating Expense	O	Expenses related to operations, e..g. personnel expenses, administrative expenses.	Gutiérrez-Nieto et al. (2007), Berger and Humphrey (1997), 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.	To the best of knowledge, 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), Berger and Humphrey (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Kipesha (2012), and Haq et al. (2010)	Numerical

Outputs	Initial	Definition	Usage in literatures	Unit	MFI Objective (Efficiency) Represented
Financial Revenue	F	Revenues from loan portfolio (incl. margin rate in IMFIs loan) plus revenues from other financial assets	Gutiérrez-Nieto et al. (2009) and Hassan & Sanchez (2009).	USD '000	Sustainability (Financial Efficiency)
Inverse of Average Loan Balance (standardised over GNI per Capita)	I	Inverse form of average loan balance standardised over gross national income (GNI). Standardised to represent purchasing power and to remove currency value differences. Used in inverse format as output	Modification from literatures. Gutiérrez-Nieto et al. (2009) use average loan borrower as index together with number of borrower.	%	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	Modification from literatures. Most literatures use number of women borrowers, e.g. Cull et al. (2007) and Nghiem et al. (2006).	Numerical	Outreach (Social Efficiency)

It should be re-emphasised herewith that even though the average loan balance over GNI per capita herein is in percentage format, it does not have the similar behaviour as financial ratio and indicator since the denominator is used only to standardise the numerator. It is different than ratio like, for example, loan per borrower as both numerator and denominator in this example can have different influence to efficiency as they can be both maximised or minimised by DEA so that the possible improvement will not be certain.

- **Number of Active Borrowers (B)**

This variable represents the number of individual or entity who currently has an outstanding loan balance with the MFI or is primarily responsible for repaying any portion of the gross loan portfolio. It is regarded as output that represents the construct of ***outreach*** (more specifically the *breadth of outreach*), i.e. MFI is increasing their programme outreach by reaching out to wider borrowers. This is a modification from literatures as many MFI studies used more specific variable of number of women borrowers as measure for breadth of outreach, e.g. Nghiem et al. (2006) and Cull et al. (2007).

Table 5.2: Input – Output Configuration in DEA Model Specifications

DEA specification (Mnemonic)	Efficiency Specification	Input variables	Output 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)

This study proposes a more general variable of number of active borrowers instead to preserve homogeneity among DMUs; IMFIs put emphasis on family borrowers as opposed to solely women borrowers (Ahmed, 2002) so using women borrowers as the sole variable for outreach may be misleading. The focus on family borrowers means that the male member of the household (which mostly the head of the household) will also be the signatories of the loan agreement, i.e. not only the female member, thus placing the repayment responsibility on them as well. This is in attempt to discourage loan misuse by male partner of the women borrowers.

V.3.3.2. DEA Model Specifications in this Study

As previously discussed, in analysing overall efficiency as well as the vital breakdown of social and financial efficiency in isolation, in parallel to technique from Berger and Humphrey (1997) and Gutiérrez-Nieto et al. (2009), three different specifications are utilised in DEA assessment in this study. The input – output configurations of each specification, which are mnemonically presented, are presented in Table 5.2.

V.4. Dataset

The dataset used in this study is from MIX Market database for 231 MFIs in three regions: Middle East and North Africa (MENA), East Asia and the Pacific (EAP) and South Asia (SA), wherein most IMFIs in database mainly operate. 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, Grameen, and FINCA, or microfinance arm of local banks, e.g. Khushhali Bank in Pakistan.

In terms of scheme, MFIs in the dataset 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 mostly located in MENA region where Islamic microloan is their major product albeit still offering conventional microloans. Table 5.3 presents summary of MFI groupings in this study. Further groupings in the dataset are as follow:

Table 5.3: Summary of MFI Groupings in First Study

	MFI Classifications															
	Scheme			MFI Age		MFI Profit Orientation		MFI Loan Portfolio Scale			Target Customer				MFI Transformation	
	Conventional	Islamic	Islamic Window	Young	Mature	Not-For-Profit	For-Profit	Small Scale	Medium Scale	Large Scale	Low End	Broad	High End	Small Business	Unregulated	Regulated
EAP	63	1	0	10	53	28	35	13	26	24	32	28	1	2	25	38
MENA	29	9	13	22	29	48	3	13	17	21	32	18	0	1	27	24
SA	113	4	0	39	78	69	48	25	37	55	97	18	2	0	31	86

- **MFI age**

  In regard to MFI age groupings in the dataset, this study reclassified three MFI age groups in MIX dataset, which was new (1-4 years), young (5-8 years), and mature (8 years plus), into two groups, i.e. young MFIs (1-8 years) and mature MFIs (8 years and older) due to small number of new MFIs in the dataset.

- **MFI profit orientation**

  MFIs in the dataset are classified into not-for-profit MFIs and for-profit MFIs. The objective is to seek empirical proof whether there is any significant influence of this orientation to MFI efficiency, as many existing microfinance literatures championed not-for-profit MFIs over the latter, e.g. Gutiérrez-Nieto et al. (2007) and Haq et al. (2010) especially in outreach (Chowdhury & Mukhopadhaya, 2012b).

- **MFI loan portfolio scale**

  Differences in MFI efficiency due to different MFI loan portfolio/scale is assessed in the second stage analysis by categorising MFIs in dataset into three groups based on gross loan portfolio, i.e. from small scale (less than USD 2 Million), medium scale (USD 2 – 8 Million), and large scale (larger than USD 8 Million), as per classification from MIX.

- **MFI target customer**

  As per classification in MIX, MFIs in the dataset are grouped due to different customer targeting based on average loan balance per borrower as percentage of GNI per capita variable. MFIs are classified into four groups, 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).

- **MFI transformation/regulatory status**

  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). Regulated MFIs are licensed as financial institutions under central bank or other authorities; it is intended to monitor MFI operation since MFIs may need to submit regular report to the authorities.

  Lafourcade et al. (2005) argued that regulated MFIs have higher efficiency yet Hartarska and Nadolnyak (2007) observed globally that regulating MFIs does not necessarily warrant better outreach and sustainability, besides providing deposit-taking authorisation. Interestingly, Haq et al., (2010) asserted that NGO-MFIs, mostly unregulated, are the most efficient under production approach. This performance vs regulatory status thus becomes interesting query to be assessed in the study.

All monetary data in dataset are in US Dollars hence comparable. As this study acts as the background study in this overall research as well as a litmus test of whether MFIs and IMFIs should be assessed separately, balanced data will be used herein prior to stepping further into model with unbalanced data at the second study. Consequently, due to many missing data in MIX Market dataset, especially regarding IMFIs, this study only uses balanced data of 2009–2010 period, of which statistical summary is reported in Table 5.4. Mean normalisation as per Sarkis (2007) is used to standardised the data to avoid 'scaling' issues in calculation as magnitude differences between some inputs and outputs are very wide. This wide gap can be observed in Table 5.4. These wide gaps stem from different size of MFIs in the dataset, which is not unusual in microfinance context as this sector is not yet established as in banking sector. Moreover, this fact thus makes the use of

VRS return to scale as main assumption in microfinance context to be more appropriate. Mean normalisation method used herein can be written as follows:

$$X_{Norm_{i0}} = X_{i0}\left[\left(\sum_{j=1}^{N} X_{ij}\right)N^{-1}\right]^{-1} \tag{5.2}$$

whereby 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.

Table 5.4: Descriptive Statistics of Input – Output for 231 MFIs in First Study

	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

The correlation within inputs and within outputs in the dataset is presented in Table 6. Spearman's Rho correlations in Table 5.5 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. By definition, these strong relationships do not necessarily imply causal relationship; in addition to this, DEA algorithm will assign weights to these variables and maximise them according to their weights. On the contrary, the presence of high correlation herein confirms that the use of parametric efficiency measurement method may not be appropriate due to multicollinearity 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 5.5: 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 (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	

Nevertheless, as previously mentioned in Section I.1.5.3, a proviso should be made in the interpretation of the analysis results herein. The current limitation facing microfinance research at the moment is that the secondary dataset in the MIX Market are mostly sourced from voluntary data submission from MFIs globally. As such, not all MFIs operating in the regions analysed herein have submitted their data to MIX Market since the proportion of existing MFIs which submit their data to MIX Market are noted to be below all below all MFIs operating globally (Balkenhol, 2007). This can also be seen by the limited number of IMFIs that can be included in the analysis for East Asian regions. However, MIX Market is considered to be the best data clearinghouse for microfinance at the moment, whose data covers widest regions globally and includes most, if not all, large and long-running MFIs globally. Thus, the data utilised herein is perceived to be the best balanced sample available in regard to inputs and outputs considered herein for the regions and periods analysed. Yet, the results of the analysis herein should be interpreted with regard to this limitation.

V.5. First Stage Analysis: DEA

At this stage, 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, regional frontiers, and Islamic frontier, yet complimented with results highlights from CRS model and also both VRS and CRS input-orientated. Thereafter, efficiency scores are plotted into the proposed ***social – financial efficiency matrix*** or hereinafter proposed to be termed as ***SFE matrix***, i.e. a matrix drawn with social efficiency at X axis and financial efficiency at Y axis to observe MFI positioning regarding these objectives. The matrix area is divided into four quadrants counter-clockwise: from quadrant I in top right for high social – high financial efficiency (the ideal quadrant where both objectives are relatively pursed concurrently) until quadrant IV in bottom right for high social efficiency – low financial efficiency area. This matrix is used in the first and second study of this research. This matrix is proposed in this overall research as one of its contribution, i.e. a performance assessment tool for MFI stakeholders and analysts to enhance the evaluation of MFI efficiency mapping against its dual bottom objectives, which will augment the understanding from overall efficiency scores.

Based on its theoretical model and mission, it is presumed in this study 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. This presumption will then be compared to the results from the DEA analysis.

V.5.1. DEA Analysis Results - Global Frontier

V.5.1.1. Overall Efficiency (AORE-FIB Specification)

As presented in Table 5.6, Islamic/window MFIs relative to 2009 global frontier show lower mean of VRS overall efficiency (pure overall efficiency) than conventional MFIs by 75.32% versus 78.24%, which is 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 marginally closer to MPSS. Thus, these lead to higher mean CRS overall efficiency (global overall efficiency) of conventional MFIs, i.e. 73.02% against 69.10%.

Table 5.6: Output-orientated TE Summary – Global Frontier 2009

Islamic/Windows MFIs		2009 Frontier								
		VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total		27	27	27	27	27	27	27	27	27
Mean		75.3200	65.1081	44.7096	69.1026	56.2556	35.9137	92.0171	89.5276	80.3031
Std. Error of Mean		4.40984	5.19474	6.08554	4.21454	4.75202	5.74229	2.21002	3.57146	4.51134
Median		84.6300	68.6000	40.2500	72.5000	59.2400	26.0300	96.5123	95.9312	91.9138
Std. Deviation		22.91418	26.99264	31.62141	21.89938	24.69221	29.83780	11.48358	18.55787	23.44160
Skewness		-.545	-.460	.669	-.435	-.426	1.077	-2.034	-3.508	-1.081
Std. Error of Skewness		.448	.448	.448	.448	.448	.448	.448	.448	.448
Minimum		24.55	11.56	2.42	22.92	9.22	2.41	58.17	9.22	28.47
Maximum		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	51.4100	50.1200	21.0000	51.3500	42.2400	12.8900	90.2075	88.6639	65.0498
	50	84.6300	68.6000	40.2500	72.5000	59.2400	26.0300	96.5123	95.9312	91.9138
	75	96.9900	91.0200	65.7600	82.8000	74.3200	59.4100	99.6937	98.5714	99.6240
Fully Efficient DMU		5	4	3	3	1	2			
% of Fully Efficient DMU		18.50	14.80	11.10	11.10	3.70	7.40			
DMU with score <50.00		4	6	18	6	10	20			
% of DMU with score		14.80	22.20	66.70	22.20	37.00	74.10			

Conventional MFIs		2009 Frontier								
		VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total		204	204	204	204	204	204	204	204	204
Mean		78.2392	71.2772	54.3718	73.0177	66.5295	46.4116	93.6024	93.9937	81.4282
Std. Error of Mean		1.23098	1.29739	2.08103	1.20660	1.19374	2.05105	.58989	.59144	1.23668
Median		76.9450	70.2350	53.8900	71.8100	65.8100	46.4750	97.4216	97.1031	84.3459
Std. Deviation		17.58195	18.53040	29.72300	17.23373	17.04996	29.29484	8.42526	8.44748	17.66329
Skewness		-.362	.077	.067	-.049	.301	.284	-1.775	-2.382	-1.266
Std. Error of Skewness		.170	.170	.170	.170	.170	.170	.170	.170	.170
Minimum		26.53	26.53	3.16	25.97	25.97	.65	56.06	45.33	2.88
Maximum		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles	25	65.5775	56.8500	30.1950	61.9575	53.8375	20.6100	89.8874	91.3457	71.8746
	50	76.9450	70.2350	53.8900	71.8100	65.8100	46.4750	97.4216	97.1031	84.3459
	75	97.4450	86.9200	75.1675	86.9325	75.2600	67.6325	99.6204	99.6526	97.0103
Fully Efficient DMU		44	28	28	22	14	14			
% of Fully Efficient DMU		21.60	13.70	13.70	10.80	6.90	6.90			
DMU with score <50.00		10	23	93	15	34	109			
% of DMU with score		4.90	11.30	45.60	7.40	16.70	53.40			

Against 2010 global frontier as depicted in Table 5.7, 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 relative to MPSS represented by the CRS condition.

Table 5.7: Output-orientated TE Summary – Global Frontier 2010

Islamic/Windows MFIs	2010 Frontier								
	VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total	27	27	27	27	27	27	27	27	27
Mean	82.4800	73.4667	48.0426	75.1904	61.7026	39.9059	91.2924	86.7634	84.1811
Std. Error of Mean	3.90813	5.37851	6.08515	4.05990	5.12115	5.86639	2.35897	3.74463	4.30828
Median	87.6800	76.9400	45.1600	73.8700	58.7200	31.9600	96.1207	93.7873	93.1931
Std. Deviation	20.30725	27.94754	31.61934	21.09588	26.61028	30.48267	12.25758	19.45769	22.38645
Skewness	-.787	-.755	.427	-.316	-.242	.861	-1.715	-2.718	-1.658
Std. Error of Skewness	.448	.448	.448	.448	.448	.448	.448	.448	.448
Minimum	38.87	8.46	3.52	29.98	8.26	3.24	58.53	10.55	27.32
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	67.8400	56.9800	15.7600	58.5300	50.0600	12.5400	90.1158	85.4347	84.1475
50	87.6800	76.9400	45.1600	73.8700	58.7200	31.9600	96.1207	93.7873	93.1931
75	100.0000	100.0000	66.2900	100.0000	85.5600	53.5900	100.0000	98.1995	98.9286
Fully Efficient DMU	12	9	4	7	3	3			
% of Fully Efficient DMU	44.40	33.30	14.80	25.90	11.10	11.10			
DMU with score <50.00	2	5	15	2	6	20			
% of DMU with score <50.00	7.40	18.50	55.60	7.40	22.20	74.10			

Conventional MFIs	2010 Frontier								
	VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total	204	204	204	204	204	204	204	204	204
Mean	79.3131	72.9372	57.0289	75.3438	67.5598	52.0620	95.0348	93.1827	88.8482
Std. Error of Mean	1.22165	1.29155	2.17341	1.23822	1.20110	2.20355	.57072	.66659	1.13948
Median	78.8350	73.0000	58.8750	73.0650	67.1250	50.8550	98.7536	97.4069	95.8349
Std. Deviation	17.44868	18.44703	31.04252	17.68527	17.15507	31.47295	8.15149	9.52075	16.27510
Skewness	-.346	-.096	-.003	-.186	.050	.112	-2.984	-2.477	-2.532
Std. Error of Skewness	.170	.170	.170	.170	.170	.170	.170	.170	.170
Minimum	29.47	28.88	3.00	16.71	16.71	1.39	36.68	31.37	2.59
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	66.7950	58.7925	28.7750	63.3450	56.7275	21.5250	93.5901	90.5467	83.5612
50	78.8350	73.0000	58.8750	73.0650	67.1250	50.8550	98.7536	97.4069	95.8349
75	100.0000	88.5750	85.8500	91.5100	77.8300	78.3875	99.9720	99.5818	99.3806
Fully Efficient DMU	55	31	40	39	15	22			
% of Fully Efficient DMU	27.00	15.20	19.60	19.10	7.40	10.80			
DMU with score <50.00	11	22	90	14	27	102			
% of DMU with score <50.00	5.40	10.80	44.10	6.90	13.20	50.00			

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 against

2010 global frontier it is higher at 67.84% against MFIs at 66.79%. Generally, IMFIs performance compared to MFIs vis-à-vis overall objective raises an alarm for its proponents because firstly, the overall performance represented by average overall efficiency scores herein do not show a meaningful advantage over that of MFIs, despite the intention and supposedly improved scheme. Secondly, the gap in scale efficiency between IMFIs and MFIs is wider in 2010, showing a farther performance from MPSS relative to conventional MFIs.

V.5.1.2. Financial Efficiency (AORE-F Specification)

Consistent to expectation, against 2009 global 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 MFIs, i.e. 56.26% versus 66.53%, respectively, indicating its generally farther distance to optimal scale. Relative to 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.

The high average scale efficiency scores for both MFIs and IMFIs nonetheless show that the major cause of financial inefficiency is mainly pure technical efficiency. These TE results also show that on average IMFIs are able to deliver comparable performance with conventional MFIs, noting that relatively smaller number of IMFIs in the sample. Yet, scale efficiency is also an issue for Islamic/window MFIs, i.e. their marginal advantage over conventional MFIs in average pure technical efficiency under 2010 frontier are diluted from lower scale efficiency vis-à-vis financial objective compared to conventional MFIs. This then hurts their efficiency in relation to their MPSS, i.e. showing that their relatively farther distant to MPSS.

V.5.1.3. Social Efficiency (AORE-IB Specification)

Surprisingly, it is found that 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 also 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 found is amongst conventional MFIs, which is 3.00% compared to 3.24% amongst Islamic/window MFIs.

These results challenge initial expectation that Islamic/window MFIs, with schemes intended 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.

V.5.1.4. Social – Financial Efficiency Matrix (SFE Matrix)

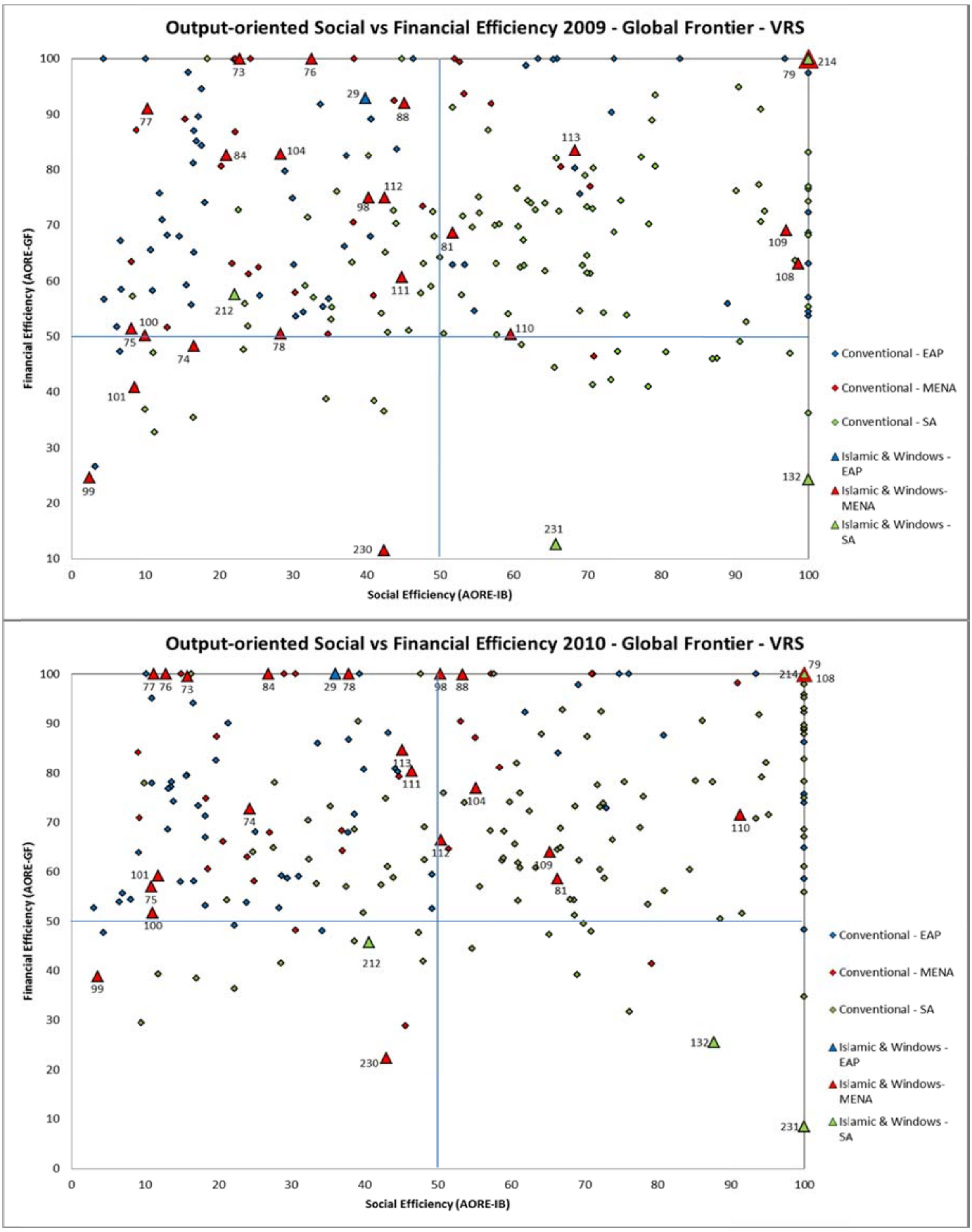
Figure 5.1 introduced the SFE matrix that is intended to enhance the understanding of MFI performance mapping against its dual objectives. Thus, overall efficiency will be the indicator of overall MFI performance, yet it is will not be complete without augmented by the mapping shown in SFE matrix to pursue improvement in both objectives. The SFE matrix for the global frontier under CRS can be referred to in Appendix 1.

In Figure 5.1, 14 out of 27 IMFIs are plotted in quadrant II relative to 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 5.1: SFE Matrix 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 it does not charge any interest or margin to its borrowers; borrowers only repay the amount they borrow without any addition – via Islamic contract called qard al-hasan as discussed in Section II.4.3. Akhuwat covers its entire operation from voluntary donations (Obaidullah & Khan, 2008).

V.5.1.5. Highlights of SFE Matrix from Input-orientated TE – Global Frontier:

Appendix 2 and 3 present the SFE matrix for global frontier in input-orientated strategy under VRS and CRS. Since this research put more focus on output-orientated MFI strategy, highlights from input-orientation approach is served as comparison in regard to the MFI positioning in SFE matrix. Relative to 2009 frontier, MFIs and IMFIs are almost evenly distributed along the quadrant I and II, with more located in the latter. Even though a bit more Islamic/windows MFIs are located in quadrant II, almost equal numbers located in quadrant I under VRS technology. However, in regard to its distance to the MPSS (CRS frontier), most of IMFIs are located in quadrant II; this shows that the scale efficiency in regard to outreach reduces their CRS TE scores. Conventional MFIs have on generally higher social efficiency than IMFIs, even though they are comparable in financial efficiency.

Against 2010 frontier, more IMFIs are mapped in quadrant I under VRS, showing a satisfactory pure technical efficiency in regard to both objectives. However, the scale efficiency once more had detrimental effect to their CRS TE; many of IMFIs are mapped in quadrant II after taking account their scale efficiency. Thus, it is argued that scale efficiency is that major cause of inefficiency in terms of social outreach objective.

V.5.2. DEA Results from Regional and Islamic Frontiers

The results from three regional frontiers and Islamic frontier in output-orientation approach are presented below. The SFE matrix from VRS input-orientation approach for these three regional and Islamic frontiers can be found in Appendix 4 - 7 as comparison.

V.5.2.1. East Asia and the Pacific (EAP) frontier

The summary of DEA results on EAP frontier is presented in Table 5.8. Since there is only one IMFI herein, the result cannot be separated between IMFIs and MFIs although comparison will still be made in result explanation. 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 observed to be generally technical inefficiency in both measures, which is indicated by the high average scale efficiency scores of more than 90% in general related to both measures. Only one MFI that scores below 50% in these measures under VRS in these measures in 2009 and none in 2010.

In regard to IMFI, the only IMFI in EAP region recorded in the dataset, AIM Malaysia is fully efficient in both overall and financial efficiency relative to both frontiers and fully scale-efficient in financial efficiency, which shows that it operates at MPSS in regard to financial sustainability. This confirms the reputation of Malaysia as being the centre of effective Islamic banking and finance, with currently the best infrastructure in this sector amongst other countries in the world (Chong & Liu, 2009).

However, in regard to outreach objective, the picture is somewhat different. 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. There are 30 and 33 MFIs with social efficiency scores below 50% in 2009 and 2010 frontiers, respectively. This may prompt further research in this research as to how MFIs can reach more borrower in need.

Table 5.8: Output-orientated TE Summary – EAP Frontier 2009-10

EAP MFIs	2009 Frontier								
	VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total	63	63	63	63	63	63	63	63	63
Mean	87.7348	85.1483	57.1797	84.5189	81.1344	50.3368	96.3392	95.3452	90.1398
Std. Error of Mean	1.91649	2.00646	4.01863	1.99234	2.05105	3.87736	0.77106	0.84401	2.29581
Median	96.6500	87.2400	53.1400	87.0600	82.2100	44.3900	99.2568	98.3011	97.8616
Std. Deviation	15.21164	15.92580	31.89688	15.81368	16.27968	30.77561	6.12009	6.69909	18.22244
Skewness	-1.299	-.895	.129	-.902	-.515	0.424	-2.317	-1.890	-3.028
Std. Error of Skewness	.302	.302	.302	.302	.302	.302	.302	.302	.302
Minimum	29.29	29.29	5.21	28.56	28.56	5.04	68.30	68.70	10.44
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	77.7700	69.5100	27.4400	71.3000	66.3700	21.4800	94.6169	94.4509	88.6161
50	96.6500	87.2400	53.1400	87.0600	82.2100	44.3900	99.2568	98.3011	97.8616
75	100.0000	100.0000	100.0000	100.0000	100.0000	74.3500	100.0000	100.0000	99.7887
Fully Efficient DMU	28	23	16	22	17	9			
% of Fully Efficient DMU	44.40	36.50	25.40	34.90	27.00	14.30			
DMU with score <50.00	1	1	30	1	1	36			
% of DMU with score	1.60	1.60	47.60	1.60	1.60	57.10			

EAP MFIs	2010 Frontier								
	VRS AORE-FIB	VRS AORE-F	VRS AORE-IB	CRS AORE-FIB	CRS AORE-F	CRS AORE-IB	SE AORE-FIB	SE AORE-F	SE AORE-IB
Total	63	63	63	63	63	63	63	63	63
Mean	88.9976	87.9690	53.0600	85.3635	83.2903	47.4716	95.9037	94.8378	90.7984
Std. Error of Mean	1.76171	1.77336	3.98841	1.90623	1.94775	3.88157	0.95202	1.21865	2.09835
Median	96.1100	93.8400	45.2400	90.0700	87.1600	40.6800	99.7100	99.2740	98.1132
Std. Deviation	13.98311	14.07562	31.65704	15.13023	15.45983	30.80903	7.55646	9.67271	16.65514
Skewness	-.944	-.802	.328	-.695	-.559	.584	-2.248	-2.689	-3.167
Std. Error of Skewness	.302	.302	.302	.302	.302	.302	.302	.302	.302
Minimum	56.10	56.10	4.77	47.58	47.58	4.68	68.68	49.06	9.47
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	75.7700	75.6400	25.1100	71.5500	69.4500	19.8800	95.7262	94.0929	89.2790
50	96.1100	93.8400	45.2400	90.0700	87.1600	40.6800	99.7100	99.2740	98.1132
75	100.0000	100.0000	80.7200	100.0000	99.7100	69.9500	100.0000	100.0000	99.4206
Fully Efficient DMU	29	26	13	19	15	9			
% of Fully Efficient DMU	46.00	41.30	20.60	30.20	23.80	14.30			
DMU with score <50.00	0	0	33	1	2	37			
% of DMU with score	0.00	0.00	52.40	1.60	3.20	58.70			

The sole IMFI in the region, AIM Malaysia, exhibited social efficiency scores which is above average with 70.76% (2009 frontier) and 67.62% (2010 frontier) albeit marginally above mediocre scale efficiency of 64.75% and 67.55%. Indeed, these figures indicating both technical inefficiency and operational scale problems faced by AIM.

In the SFE matrix in Figure 5.2a and 5.2b, it can be observed instantly that most of the MFIs in this regions are mapped in quadrant II. The positioning of AIM Malaysia (DMU 29 with triangle shape in the matrix) in both frontiers related to social efficiency are affected by scale inefficiency. This findings reiterate the benefit of using SFE matrix in assessing MFI performance so that comprehensive performance can be tracked and monitored easily, instead of overall efficiency or financial and social efficiency in isolation

Figure 5.2a: SFE Matrix 2009 Frontier – VRS & CRS EAP Frontier

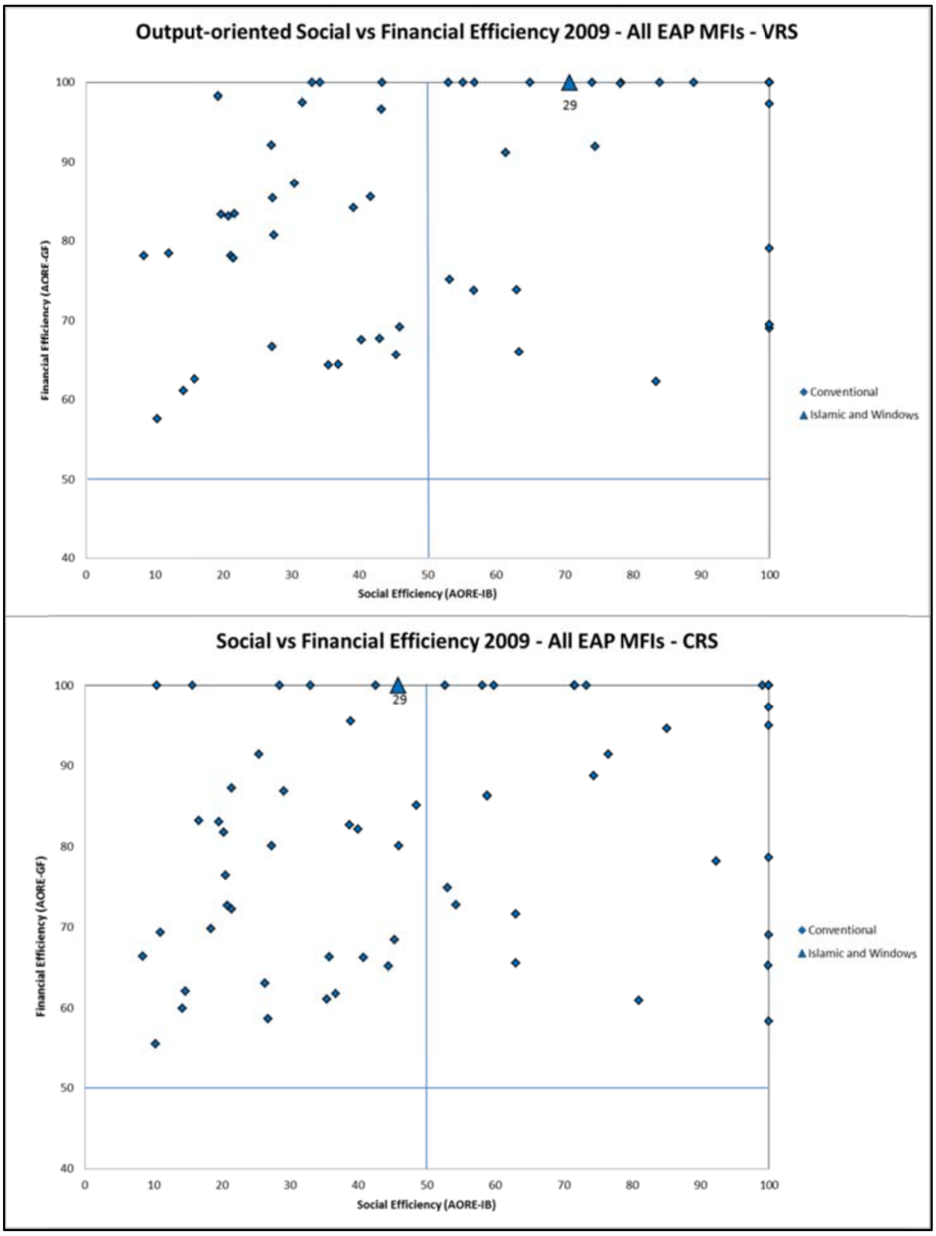
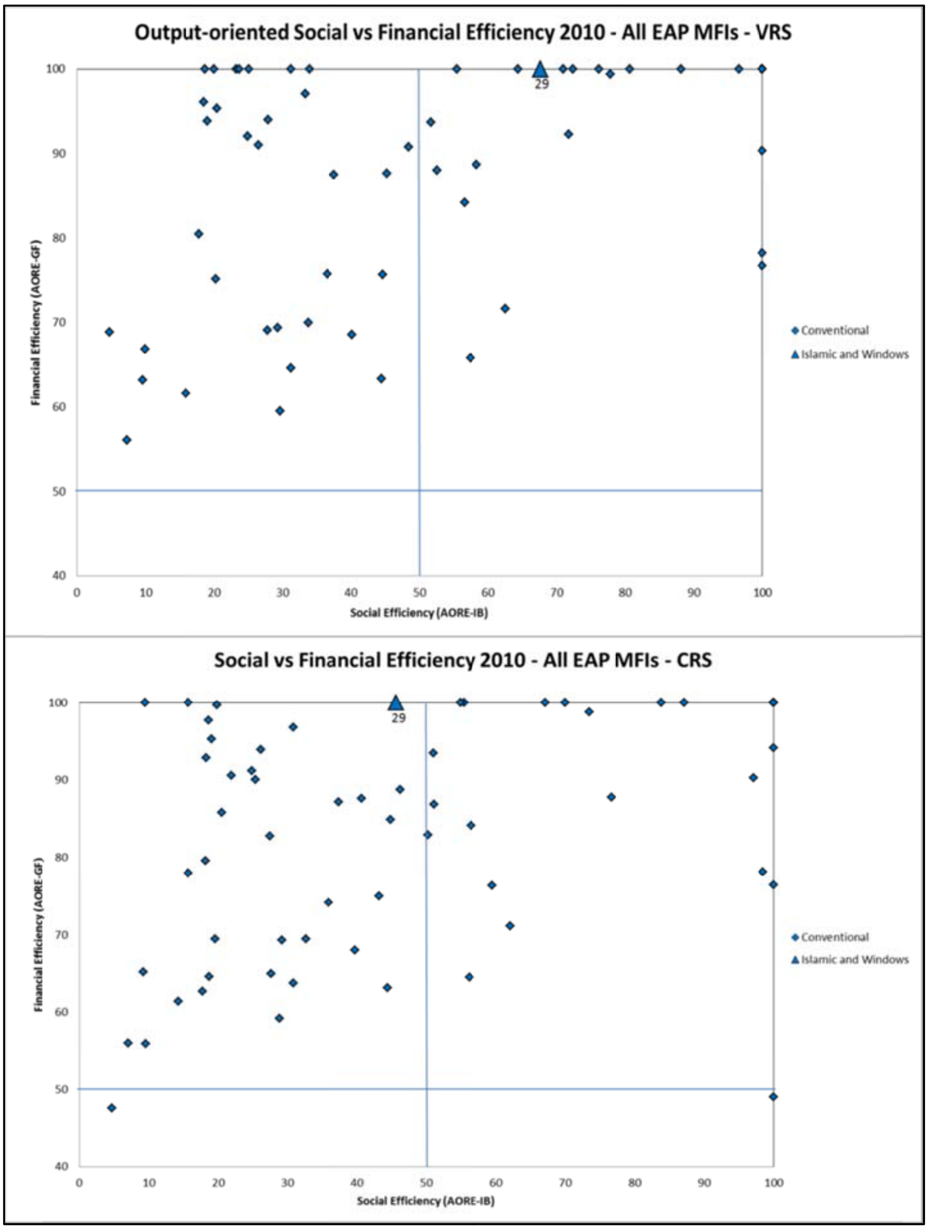


Figure 5.2b: SFE Matrix 2010 Frontier – VRS & CRS EAP Frontier



V.5.2.2. 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, indicating technical efficiency is main source of inefficiency. Against 2010 frontier, Islamic/window MFIs marginally outperformed conventional MFIs in this measure with also higher scale efficiency.

Table 5.9a: Output-orientated TE Summary – MENA Frontier 2009

Islamic/Window MFIs	VRS AORE-FIB 09	VRS AORE-F 09	VRS AORE-IB 09	CRS AORE-FIB 09	CRS AORE-F 09	CRS AORE-IB 09	SE AORE-FIB 09	SE AORE-F 09	SE AORE-IB 09
	2009 Frontier								
Total	22	22	22	22	22	22	22	22	22
Mean	81.16	74.18	59.54	76.51	63.43	53.04	97.12	93.49	90.06
Std. Error of Mean	5.26	5.58	6.72	5.27	4.66	6.16	1.33	1.82	2.56
Median	97.95	82.69	58.52	80.74	65.99	54.54	99.58	97.31	94.44
Std. Deviation	24.69	26.16	31.51	24.70	21.84	28.89	6.25	8.56	12.01
Skewness	-0.951	-0.896	0.087	-0.755	-0.628	0.364	-3.059	-1.512	-1.536
Std. Error of Skewness	.491	.491	.491	.491	.491	.491	.491	.491	.491
Minimum	24.90	11.56	11.03	23.41	11.31	9.16	73.87	73.40	57.12
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	55.99	53.10	32.79	52.91	50.94	29.01	96.54	90.84	84.06
50	97.95	82.69	58.52	80.74	65.99	54.54	99.58	97.31	94.44
75	100.00	99.42	100.00	100.00	78.59	73.25	100.00	99.45	99.54
Fully Efficient DMU	11	5	6	7	1	3			
% of Fully Efficient DMU	50.00	22.70	27.30	31.80	4.50	13.60			
DMU with score <50.00	3	3	10	4	4	10			
% of DMU with score <50.00	13.60	13.60	45.50	18.20	18.20	45.50			

Conventional MFIs	VRS AORE-FIB 09	VRS AORE-F 09	VRS AORE-IB 09	CRS AORE-FIB 09	CRS AORE-F 09	CRS AORE-IB 09	SE AORE-FIB 09	SE AORE-F 09	SE AORE-IB 09
	2009 Frontier								
Total	29	29	29	29	29	29	29	29	29
Mean	88.69	83.37	71.26	83.34	75.06	61.43	96.45	94.16	86.32
Std. Error of Mean	2.92	3.35	4.95	3.36	3.50	4.91	1.69	2.37	2.56
Median	98.39	92.40	76.69	87.77	77.03	57.77	99.83	99.35	90.70
Std. Deviation	15.73	18.02	26.64	18.09	18.83	26.42	9.12	12.78	13.78
Skewness	-1.195	-0.623	-0.368	-0.735	-0.177	0.226	-3.086	-2.709	-1.066
Std. Error of Skewness	.434	.434	.434	.434	.434	.434	.434	.434	.434
Minimum	51.72	49.22	17.62	44.93	43.97	16.92	61.26	46.70	56.96
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	77.68	65.18	49.40	65.70	59.95	40.02	98.45	97.86	77.77
50	98.39	92.40	76.69	87.77	77.03	57.77	99.83	99.35	90.70
75	100.00	100.00	100.00	100.00	91.93	90.99	100.00	100.00	95.92
Fully Efficient DMU	14	9	9	10	4	5			
% of Fully Efficient DMU	48.30	31.00	31.00	34.50	13.80	17.20			
DMU with score <50.00	0	1	8	1	3	11			
% of DMU with score <50.00	0.00	3.40	27.60	3.40	10.30	37.90			

Consistent with presumption, conventional MFIs generally outperform Islamic/windows MFI in financial efficiency and in financial scale efficiency in 2009 frontier; however, IMFIs topped them relative to 2010 frontier with marginally higher mean financial efficiency and mean scale efficiency. This shows improvement in IMFIs performance relative to MFIs in 2010 frontier in these two measures. However, one plausible reason suggested thereto was 2010 Moroccan microfinance crisis weakening average of all conventional MFIs, not IMFIs superior performance. This is due to the fact that all Moroccan MFIs included in the dataset are conventional MFIs.

Table 5.9b: Output-orientated TE Summary – MENA Frontier 2010

Islamic/Window MFIs	2010 Frontier VRS AORE-FIB 10	VRS AORE-F 10	VRS AORE-IB 10	CRS AORE-FIB 10	CRS AORE-F 10	CRS AORE-IB 10	SE AORE-FIB 10	SE AORE-F 10	SE AORE-IB 10
Total	22	22	22	22	22	22	22	22	22
Mean	86.72	83.80	66.30	81.63	71.79	52.53	96.67	94.68	83.60
Std. Error of Mean	4.31	5.04	6.76	4.27	4.73	5.59	1.48	2.32	4.08
Median	100.00	100.00	75.49	85.54	65.62	49.51	99.74	98.54	91.37
Std. Deviation	20.22	23.63	31.71	20.03	22.16	26.22	6.93	10.89	19.11
Skewness	-1.290	-1.215	-0.507	-0.774	-0.164	0.260	-3.404	-2.470	-1.235
Std. Error of Skewness	.491	.491	.491	.491	.491	.491	.491	.491	.491
Minimum	39.89	23.45	9.89	39.88	23.01	8.85	68.83	59.42	39.56
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	75.45	63.46	27.22	67.36	56.44	26.36	94.69	97.26	73.05
50	100.00	100.00	75.49	85.54	65.62	49.51	99.74	98.54	91.37
75	100.00	100.00	100.00	100.00	98.63	75.21	100.00	100.00	98.31
Fully Efficient DMU	13	13	6	9	5	2			
% of Fully Efficient DMU	59.10	59.10	27.30	40.90	22.70	9.10			
DMU with score <50.00	2	2	7	2	2	11			
% of DMU with score <50.00	9.10	9.10	31.80	9.10	9.10	50.00			

Conventional MFIs	2010 Frontier VRS AORE-FIB 10	VRS AORE-F 10	VRS AORE-IB 10	CRS AORE-FIB 10	CRS AORE-F 10	CRS AORE-IB 10	SE AORE-FIB 10	SE AORE-F 10	SE AORE-IB 10
Total	29	29	29	29	29	29	29	29	29
Mean	85.62	82.15	70.86	80.18	74.07	55.85	94.75	93.16	77.69
Std. Error of Mean	3.13	3.67	5.21	3.67	4.07	5.57	2.18	2.21	4.01
Median	94.93	90.09	75.63	80.23	72.61	45.71	97.94	97.18	78.13
Std. Deviation	16.87	19.76	28.08	19.75	21.90	29.99	11.72	11.93	21.57
Skewness	-0.776	-0.791	-0.344	-1.079	-0.729	0.374	-4.308	-2.918	-1.310
Std. Error of Skewness	.434	.434	.434	.434	.434	.434	.434	.434	.434
Minimum	45.55	32.08	18.07	17.44	17.22	3.77	38.29	51.88	8.28
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	71.90	68.26	47.12	66.82	63.05	30.90	94.28	91.55	68.10
50	94.93	90.09	75.63	80.23	72.61	45.71	97.94	97.18	78.13
75	100.00	100.00	100.00	100.00	94.73	89.59	100.00	99.86	98.74
Fully Efficient DMU	14	12	11	9	5	2			
% of Fully Efficient DMU	48.30	41.40	37.90	40.90	22.70	9.10			
DMU with score <50.00	1	3	9	2	2	11			
% of DMU with score <50.00	3.40	10.30	31.00	9.10	9.10	50.00			

On the other hand, conventional MFIs defy initial presumption by generally outperforming Islamic MFIs in mean and median of social efficiency in both frontiers albeit higher mean social scale efficiency of Islamic/windows MFIs. It can be observed from the distribution of MFIs in Table 5.9a and 5.9b that the mean for IMFIs are slightly higher than their median in social efficinency measures in 2009 frontier, whilst the mean for MFIs is lower than their median. This shows that relative to 2009 frontier more IMFIs were positioned in the middle to the left of the efficiency score spectrum so the it had positive tail to the right. On the other hand, the condition is reversed for MFIs. This distribution can be seen in SFE matrix at Figure 5.3a and 5.3b.

Figure 5.3a: SFE Matrix 2009 Frontier – VRS & CRS MENA Frontier

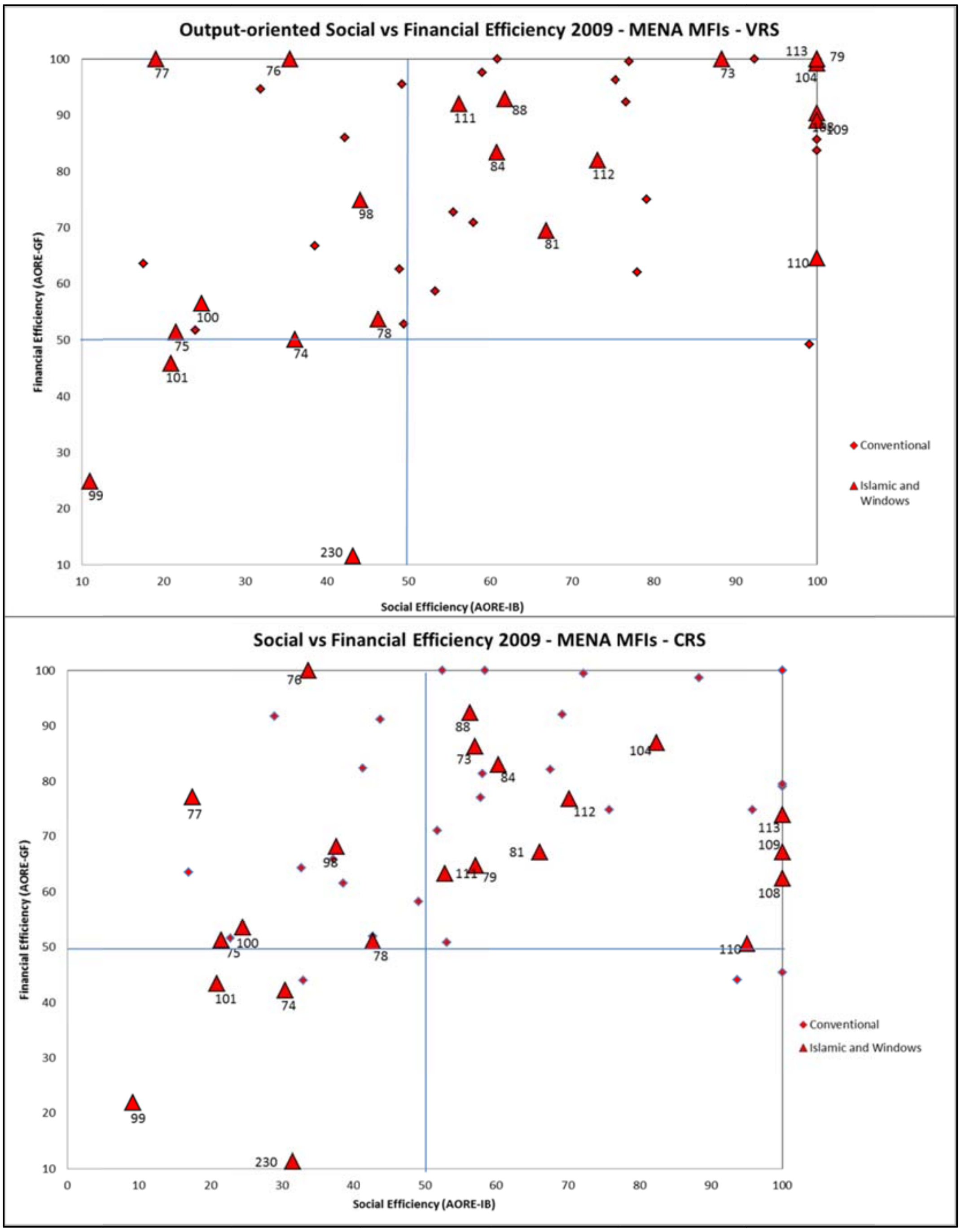
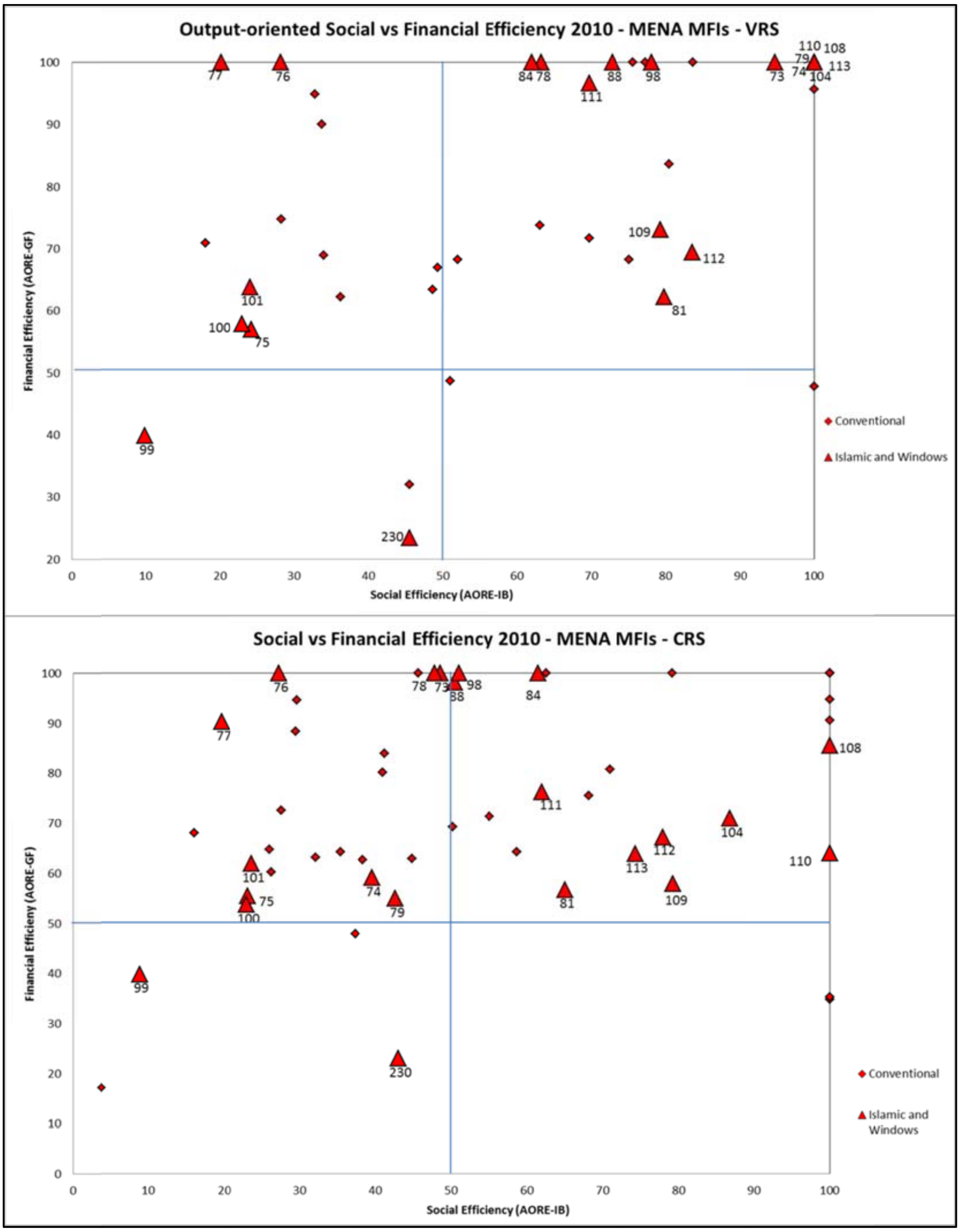


Figure 5.3b: SFE Matrix 2010 Frontier – VRS & CRS MENA Frontier



The condition for IMFIs is observed to be improved relative to 2010 frontier since mean for IMFIs was higher than its median, which can be also be seen from the mapping at the SFE matrix. SFE matrix also reveals that even though relative to 2010 frontier 9

IMFIs are fully-efficient in both social and financial efficiency, other IMFIs pulled the mean lower than that of MFIs.

These findings, and lower mean and median of overall and financial efficiency in 2009 frontier, indicate a serious wake-up call for IMFIs in the region that need serious attention thus call for further research for the cause. 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.

V.5.2.3. South Asia (SA) Regional Frontier

It can be related from Table 5.10a and 5.10b that four SA IMFIs in dataset outperformed SA conventional MFIs relative to both 2009 and 2010 frontiers in mean overall efficiency and scale efficiency pertaining to overall efficiency. Moreover, IMFIs topped MFIs by wide margin in mean social efficiency and mean social scale efficiency. Though these findings are consistent with initial expectation established for social efficiency, these are indeed unexpected in SA frontier, particularly for scale efficiency given longer operation of conventional MFIs in this region. Yet, from SFE matrices in Figure 5.4a and 5.4b three out of four IMFIs were scored very high in social efficiency. Yet, these need to be viewed cautiously given small number of IMFIs in dataset.

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 CRS efficiency from conventional MFIs in both frontiers indicate that Islamic MFIs are relatively farther to MPSS hence scale problem for IMFIs; it is shown by very low mean CRS financial efficiency of 30.58% versus 69.31% in 2009 and 28.92% versus 73.32% in 2009 for IMFIs and conventional MFIs, respectively.

It can be seen from SFE matrix that relative to both frontiers, two out of four IMFIs, DMU 132 (Muslim Aid) and DMU 231 (Akhuwat), in this region scored very low in regard to financial efficiency. These two IMFIs are purely charity-based IMFIs; as discussed previously, Akhuwat charge neither interest nor margin to loan its extended thus relying completely on voluntary donation. Muslim Aid Bangladesh (DMU 132) is an

IMFI arm of global humanitarian agency headquartered in London which also mainly relying on voluntary donation to survive. Interestingly, Farz Foundation (DMU 214) was fully-efficient in both 2009 and 2010 frontiers under VRS, yet due to its very small size in 2009 and 2010, its scale efficiency related to financial sustainability was very low in both periods. Thus it is mapped at quadrant IV under CRS assumption.

Table 5.10a: Output-orientated TE Summary – SA Frontier 2009

	2009 Frontier								
Islamic & Window MFIs	VRS AORE-FIB 09	VRS AORE-F 09	VRS AORE-IB 09	CRS AORE-FIB 09	CRS AORE-F 09	CRS AORE-IB 09	SE AORE-FIB 09	SE AORE-F 09	SE AORE-IB 09
Total	4	4	4	4	4	4	4	4	4
Mean	86.26	51.69	76.37	83.83	30.58	73.30	96.86	78.54	94.46
Std. Error of Mean	8.19	19.77	16.97	9.34	12.33	17.71	3.04	20.74	3.23
Median	88.73	45.93	88.73	83.99	20.25	83.99	99.85	99.15	95.06
Std. Deviation	16.38	39.53	33.94	18.67	24.65	35.42	6.08	41.48	6.46
Skewness	-.307	.501	-1.478	-.001	1.840	-1.097	-1.997	-2.000	-.114
Std. Error of Skewness	1.014	1.014	1.014	1.014	1.014	1.014	1.014	1.014	1.014
Minimum	67.56	14.92	28.01	67.36	14.78	25.24	87.75	16.32	87.75
Maximum	100.00	100.00	100.00	100.00	67.04	100.00	100.00	99.55	100.00
Percentiles 25	70.04	17.26	40.37	67.51	15.17	35.92	90.74	37.01	88.34
50	88.73	45.93	88.73	83.99	20.25	83.99	99.85	99.15	95.06
75	100.00	91.89	100.00	100.00	56.33	100.00	100.00	99.47	100.00
Fully Efficient DMU	2	1	2	2	0	2			
DMU with score <50.00	0	1	1	0	3	1			

	2009 Frontier								
Conventional MFIs	VRS AORE-FIB 09	VRS AORE-F 09	VRS AORE-IB 09	CRS AORE-FIB 09	CRS AORE-F 09	CRS AORE-IB 09	SE AORE-FIB 09	SE AORE-F 09	SE AORE-IB 09
Total	113	113	113	113	113	113	113	113	113
Mean	81.72	72.93	68.73	76.17	69.31	58.96	93.42	95.49	84.72
Std. Error of Mean	1.46	1.57	2.31	1.49	1.45	2.45	0.85	0.59	1.85
Median	81.15	71.18	69.90	75.15	67.69	59.97	97.17	97.83	90.65
Std. Deviation	15.50	16.71	24.58	15.82	15.46	26.02	8.99	6.29	19.71
Skewness	-0.385	.182	-0.355	-.023	.427	-0.146	-1.987	-2.368	-1.931
Std. Error of Skewness	.227	.227	.227	.227	.227	.227	.227	.227	.227
Minimum	43.25	37.01	8.22	38.69	35.76	0.65	59.95	63.97	1.72
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	71.07	59.20	52.36	65.62	58.62	39.55	90.67	92.92	78.89
50	81.15	71.18	69.90	75.15	67.69	59.97	97.17	97.83	90.65
75	100.00	85.91	93.64	87.60	78.19	78.15	99.85	99.81	99.37
Fully Efficient DMU	29	15	24	17	11	11			
% of Fully Efficient DMU	25.70	13.30	21.20	15.00	9.70	9.70			
DMU with score <50.00	3	6	26	4	7	37			
% of DMU with score <50.00	2.70	5.30	23.00	3.50	6.20	32.70			

Table 5.10b: Output-orientated TE Summary – SA Frontier 2010

Islamic & Window MFIs	2010 Frontier VRS AORE-FIB 10	VRS AORE-F 10	VRS AORE-IB 10	CRS AORE-FIB 10	CRS AORE-F 10	CRS AORE-IB 10	SE AORE-FIB 10	SE AORE-F 10	SE AORE-IB 10
Total	4	4	4	4	4	4	4	4	4
Mean	86.92	49.92	85.59	86.33	28.92	84.29	99.12	77.79	97.77
Std. Error of Mean	9.43	19.05	10.70	9.78	9.61	11.73	0.59	19.80	1.91
Median	93.84	42.44	93.84	93.40	22.23	93.40	99.50	97.40	99.50
Std. Deviation	18.86	38.10	21.41	19.57	19.22	23.46	1.19	39.60	3.81
Skewness	-1.493	0.846	-1.599	-1.462	1.641	-1.616	-1.198	-2.000	-1.911
Std. Error of Skewness	1.014	1.014	1.014	1.014	1.014	1.014	1.014	1.014	1.014
Minimum	60.01	14.80	54.68	58.50	14.40	50.36	97.48	18.40	92.10
Maximum	100.00	100.00	100.00	100.00	56.83	100.00	100.00	97.97	100.00
Percentiles 25	66.93	17.75	62.93	65.58	15.40	59.47	97.86	38.12	93.82
50	93.84	42.44	93.84	93.40	22.23	93.40	99.50	97.40	99.50
75	100.00	89.57	100.00	100.00	49.14	100.00	100.00	97.86	100.00
Fully Efficient DMU	2	1	2	2	0	2			
DMU with score <50.00	0	2	0	0	3	0			

Conventional MFIs	2010 Frontier VRS AORE-FIB 10	VRS AORE-F 10	VRS AORE-IB 10	CRS AORE-FIB 10	CRS AORE-F 10	CRS AORE-IB 10	SE AORE-FIB 10	SE AORE-F 10	SE AORE-IB 10
Total	113	113	113	113	113	113	113	113	113
Mean	84.19	76.73	72.85	80.48	73.32	66.49	95.67	95.88	90.02
Std. Error of Mean	1.48	1.67	2.39	1.54	1.58	2.58	0.72	0.59	1.55
Median	86.37	77.06	75.68	79.96	72.36	68.21	99.00	98.55	96.98
Std. Deviation	15.76	17.73	25.35	16.33	16.76	27.42	7.60	6.26	16.49
Skewness	-0.633	-0.137	-0.560	-0.373	-0.006	-0.425	-2.871	-2.336	-2.342
Std. Error of Skewness	.227	.227	.227	.227	.227	.227	.227	.227	.227
Minimum	41.36	36.28	9.92	37.35	34.38	9.13	59.10	69.16	21.09
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	72.14	62.26	52.91	69.17	60.94	45.18	94.51	94.77	88.96
50	86.37	77.06	75.68	79.96	72.36	68.21	99.00	98.55	96.98
75	100.00	95.20	100.00	98.92	85.59	92.77	100.00	99.65	99.91
Fully Efficient DMU	40	23	34	27	15	20			
% of Fully Efficient DMU	35.40	20.40	30.10	23.90	13.30	17.70			
DMU with score <50.00	3	6	24	4	8	32			
% of DMU with score <50.00	2.70	5.30	21.20	3.50	7.10	28.30			

Figure 5.4a: SFE Matrix 2009 Frontier – VRS & CRS SA Frontier

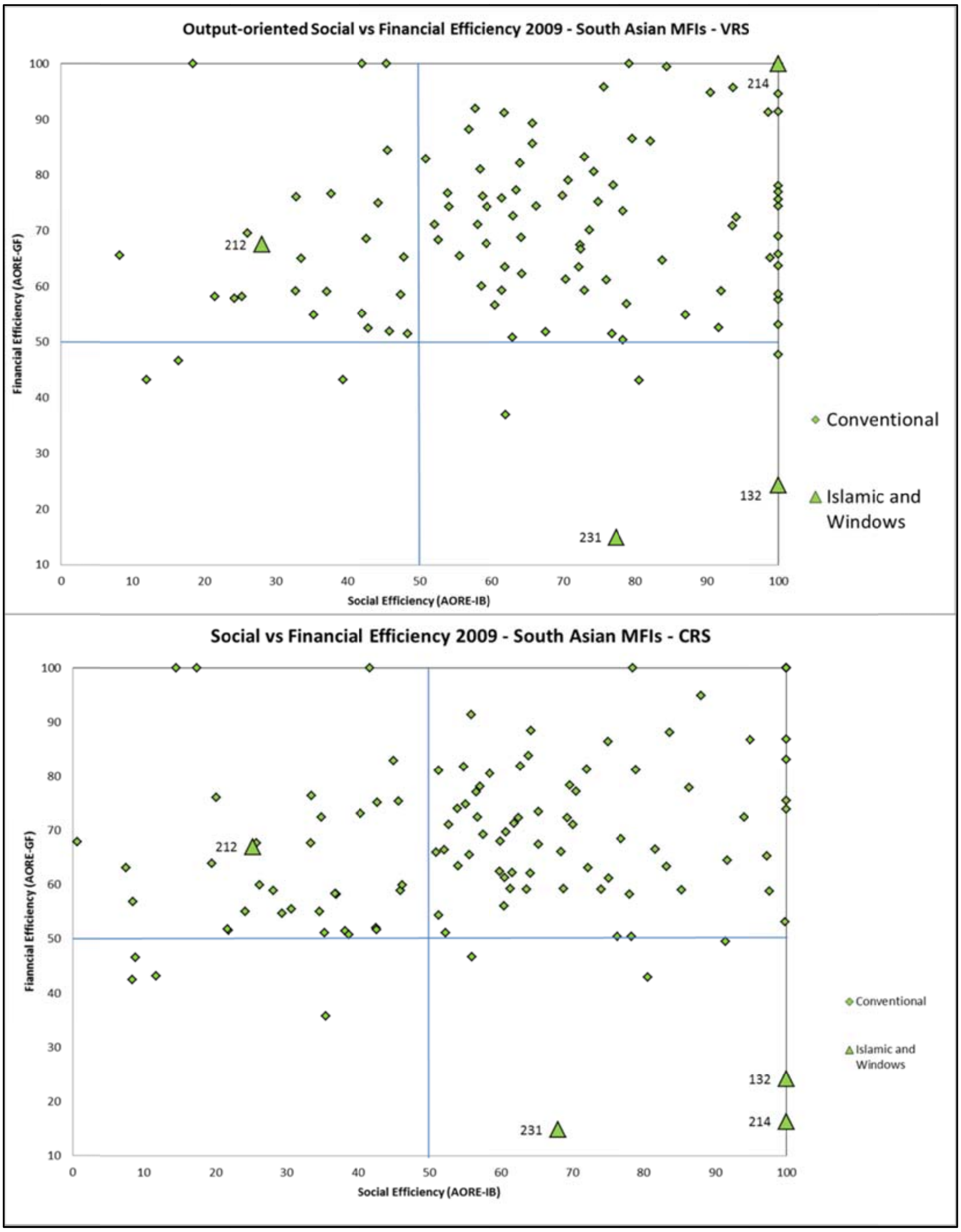
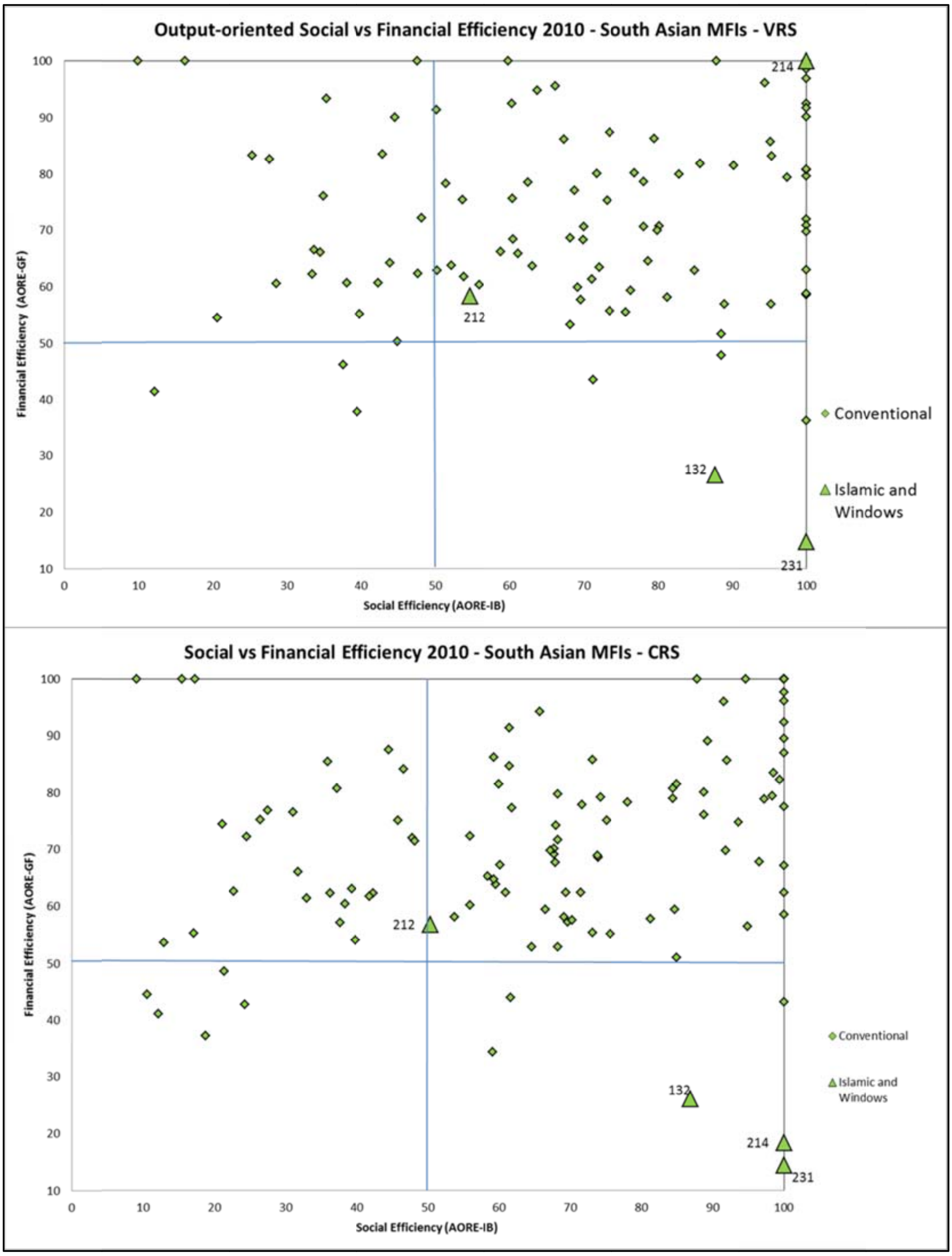


Figure 5.4b: SFE Matrix 2010 Frontier – VRS & CRS SA Frontier



V.5.2.4. Islamic frontier

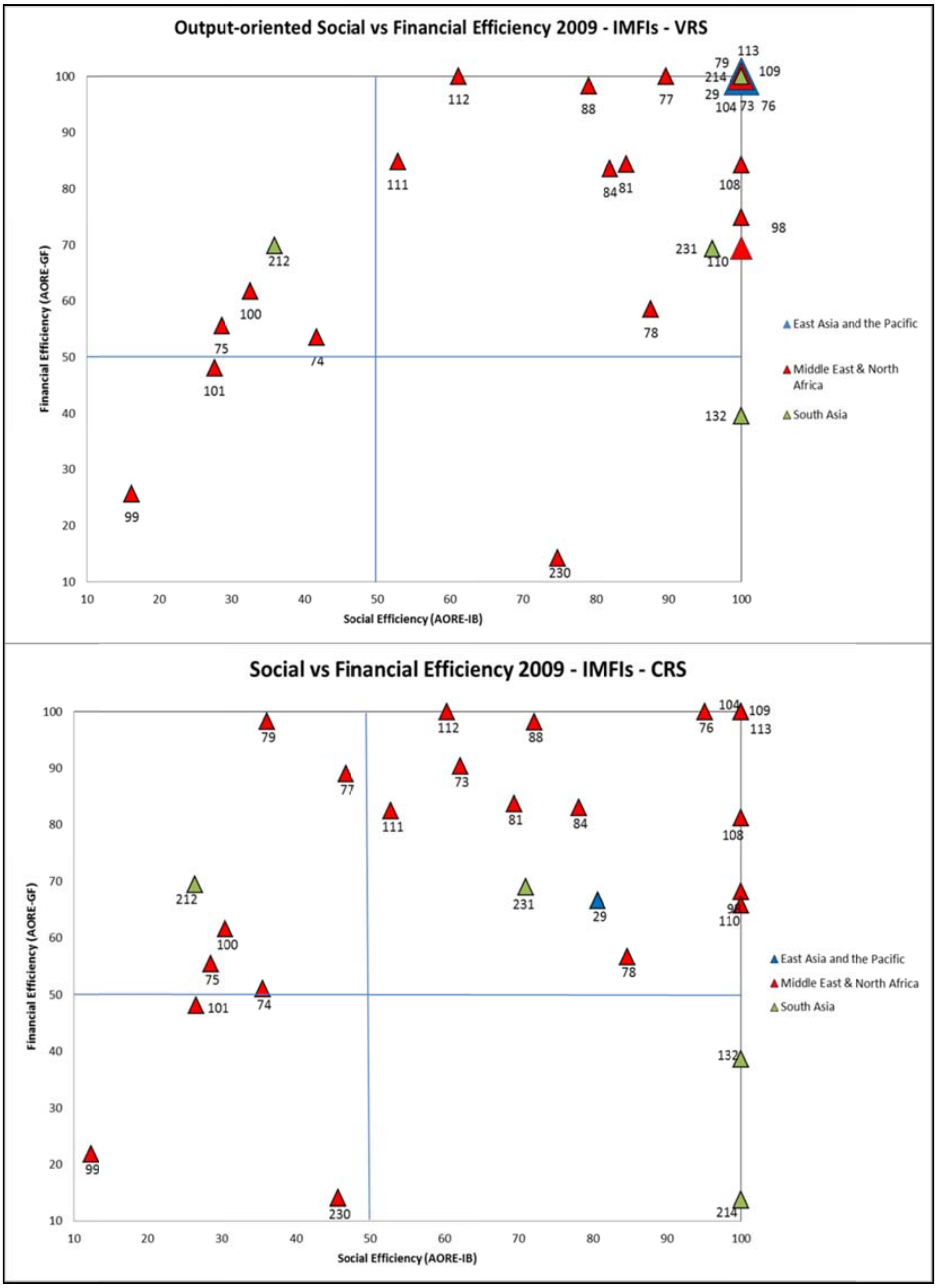
Relative to Islamic frontiers in both 2009 and 2010, IMFIs generally deliver satisfactory performance in overall, financial, and social efficiency. Majority of IMFIs are located in quadrant I of SFE matrix, which can be seen in Figure 5.5a and 5.5b. In both frontiers, mean overall efficiency and mean 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.

Table 5.11: Output-orientated TE Summary – Islamic Frontier 2009-10

	2009 Frontier								
Islamic & Window MFIs	VRS AORE-FIB 09	VRS AORE-F 09	VRS AORE-IB 09	CRS AORE-FIB 09	CRS AORE-F 09	CRS AORE-IB 09	SE AORE-GFIB 09	SE AORE-GF 09	SE AORE-IB 09
Total	27	27	27	27	27	27	27	27	27
Mean	87.44	76.88	77.40	84.06	70.62	67.19	95.97	92.91	86.96
Std. Error of Mean	3.92	4.85	5.50	4.18	5.12	5.64	1.69	3.33	3.34
Median	100.00	84.23	89.67	98.28	69.48	70.95	99.92	98.81	95.28
Std. Deviation	20.38	25.21	28.60	21.70	26.63	29.32	8.80	17.31	17.37
Skewness	-1.680	-0.919	-0.969	-1.308	-0.769	-0.296	-2.950	-4.085	-1.482
Std. Error of Skewness	.448	.448	.448	.448	.448	.448	.448	.448	.448
Minimum	25.61	14.24	16.31	24.83	13.72	12.25	61.07	13.72	36.06
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	76.79	58.56	52.84	76.25	55.43	36.06	96.68	94.85	75.11
50	100.00	84.23	89.67	98.28	69.48	70.95	99.92	98.81	95.28
75	100.00	100.00	100.00	100.00	98.24	100.00	100.00	99.91	100.00
Fully Efficient DMU	16	10	12	13	5	8			
% of Fully Efficient DMU	59.30	37.00	44.40	48.10	18.50	29.60			
DMU with score <50.00	2	4	6	3	5	9			
% of DMU with score <50.00	7.40	14.80	22.20	11.10	18.50	33.30			

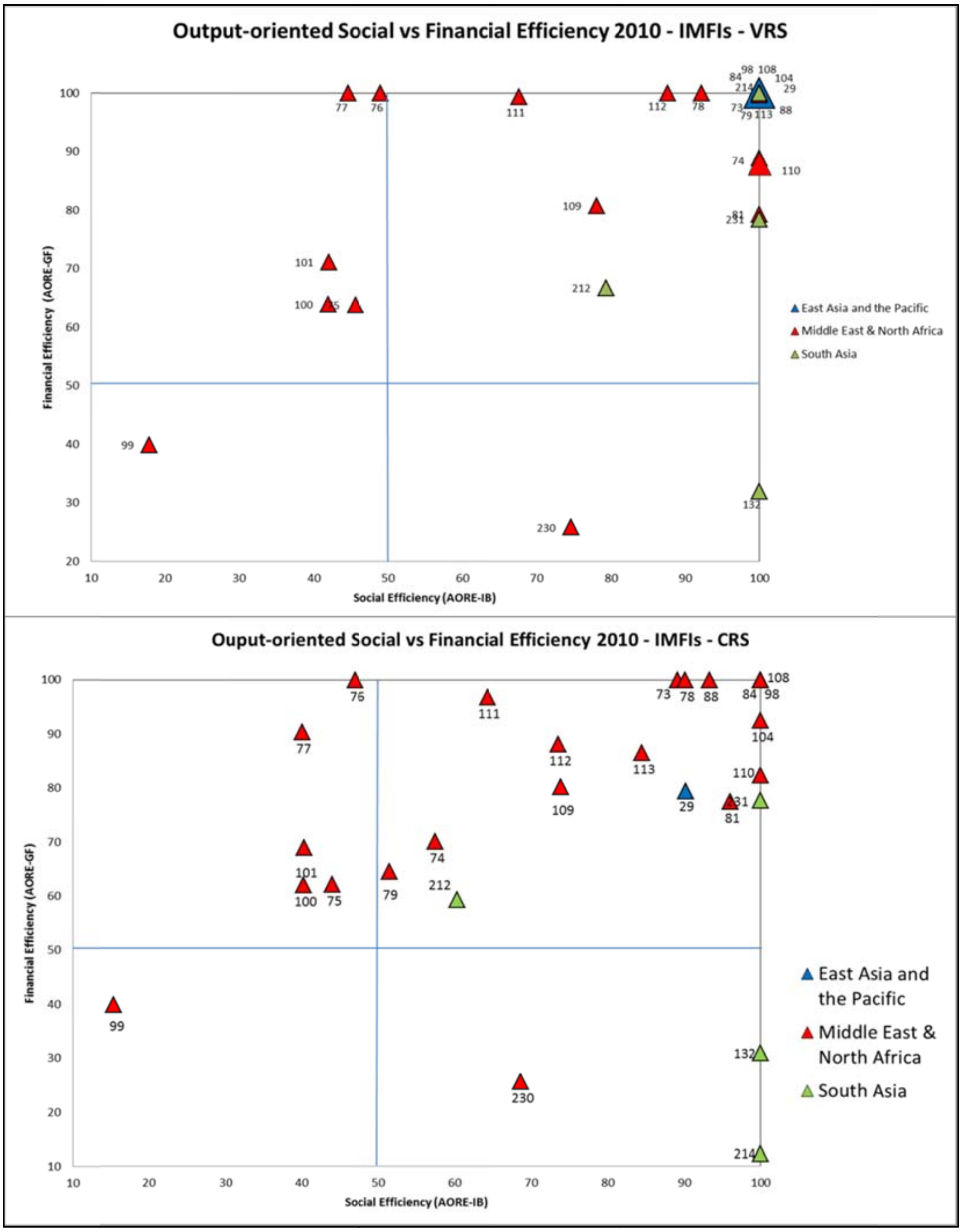
	2010 Frontier								
Islamic & Window MFIs	VRS AORE-FIB 10	CRS AORE-FIB 10	VRS AORE-F 10	CRS AORE-F 10	VRS AORE-IB 10	CRS AORE-IB 10	SE AORE-GFIB 10	SE AORE-GF 10	SE AORE-IB 10
Total	27	27	27	27	27	27	27	27	27
Mean	92.58	87.61	84.36	75.82	82.24	74.80	94.75	90.98	91.15
Std. Error of Mean	2.97	3.19	4.34	4.79	4.83	4.88	1.64	3.44	2.35
Median	100.00	97.42	99.71	80.13	100.00	84.47	97.87	97.42	95.83
Std. Deviation	15.41	16.60	22.55	24.86	25.11	25.34	8.52	17.87	12.22
Skewness	-2.221	-1.268	-1.451	-1.112	-1.192	-0.644	-1.956	-3.636	-2.238
Std. Error of Skewness	.448	.448	.448	.448	.448	.448	.448	.448	.448
Minimum	39.89	39.88	25.84	12.33	17.88	15.40	70.25	12.33	51.49
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentiles 25	93.82	70.25	71.09	62.20	67.68	51.49	91.21	88.97	89.08
50	100.00	97.42	99.71	80.13	100.00	84.47	97.87	97.42	95.83
75	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Fully Efficient DMU	19	12	13	12	7	8			
% of Fully Efficient DMU	70.40	44.40	48.10	44.40	25.90	29.60			
DMU with score <50.00	1	1	3	1	4	6			
% of DMU with score <50.00	3.70	3.70	11.10	3.70	14.80	22.20			

Figure 5.5a: SFE Matrix 2009 Frontier – VRS & CRS Islamic Frontier



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 suffered massive financial scale inefficiency. It is fully financial-efficient in both frontiers, yet due to its very small scale efficiency pertaining to its small size; its CRS financial efficiency scores are only 13.72% (2009 frontier) and 12.33% (2010 frontier).

Figure 5.5b: SFE Matrix 2010 Frontier – VRS & CRS Islamic Frontier



Scale inefficiency also impairs social efficiency performance of Al Mosanid (DMU 74) and TDMN (DMU 79), both IMFI from Iraq. 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%. One plausible explanation to this may due to unstable political situation in their operational region or perception problem regarding product compliance to religious law that barring them from increasing operational scale. Regardless, these deserve further investigation and attention.

V.6. Second Stage Analysis: Non-parametric Post DEA Analysis

The main objective of post DEA analysis at this stage is to test the statistical significance of performance differences observed in mean efficiency scores from DEA analysis, i.e. whether scheme differences of IMFIs and MFIs significantly affect differences in MFI efficiency in the dataset for 2009-2010. Moreover, this study seeks to observe several factors which may affect MFI efficiency, i.e. MFI age, MFI 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 hence sufficient.

As discussed at Section V.3.2.1, non-parametric tests that will be used at this stage are Kruskal-Wallis *H*-test complemented further by Jonckheere-Terpstra test. 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 all global, regional, and Islamic frontiers. All MFI data are therefore combined to become 462 DMUs in global frontier assessment, thereby making MFI efficiency scores equally comparable to each other relative to a single meta-frontier. A common piecewise frontier will be constructed in the meta-frontier that envelops all the data, making the scores of all DMUs comparable. Likewise, this method is performed to regional MFIs and Islamic MFIs. However, post DEA analysis on influence of MFI region of operation to efficiency can only be done on global frontier for all MFI in the dataset as small number of EAP and SA IMFIs barred this to be calculated in Islamic meta-frontier. Summaries for these post DEA analyses are presented at Appendix 8 – 14. As CRS results will be identical for both output- and input-orientated, it will only be listed once in the output-orientated result section.

V.6.1. MFI Efficiency vs MFI Schemes

Post DEA analysis herein observes whether MFI schemes affect MFI efficiency scores. As in the first stage analysis, 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. Relationship between efficiency and MFI schemes were only assessed in global, MENA and SA meta-frontiers due to only two Islamic DMUs in EAP meta-frontier. The findings from the summary in Appendix 8 are as follow:

In global meta-frontier:

(1) Higher VRS output-orientated and CRS social efficiency of conventional MFIs in global meta-frontier are found to be statistically significant yet with small effect size of 0.126 (VRS) and 0.122 (CRS). Whilst contrary to presumption, these results are consistent with first stage DEA. In input-orientation, this differences only significant if DMUs were at MPSS (at CRS).

(2) Consistent to expectation, higher financial efficiency of conventional MFIs are significant under VRS and CRS albeit small effect size of 0.059 (VRS) and 0.127 (CRS). In input-orientated model, again only CRS is significant.

(3) 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.

(4) Pertaining to overall efficiency, conventional MFIs lead over IMFIs is only found to be significant under CRS assumption with very small effect sizes of 0.070.

(5) Conventional MFIs are found to have significant higher mean scale efficiency related to financial objective with small effect on output-orientated (0.1333) and marginally medium effect on input-orientated (0.276), i.e. closer to MPSS as per expectation.

(6) In social efficiency, conventional MFIs have significant higher mean scale efficiency in input-orientated model with small size of 0.174. Conversely, IMFIs are found to have

significant higher mean scale efficiency in output-orientated but only on 85% confidence level hence negligible effect size of 0.070.

In MENA and SA meta-frontiers:

(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 but with negligible effects of 0.07 – 0.09 whilst SA conventional MFIs display higher VRS and CRS financial efficiency with more convincing small to medium effect size of 0.12 – 0.27.

V.6.2. MFI Efficiency vs MFI Operational Region

Herewith, regions in observation are arranged in three ranked order according to adoption of microfinance therein from pioneer to late adopter: starting with group 1 (South Asia), group 2 (EAP), and finally MENA as group 3. Assessment is only performed for global meta-frontier as it is not possible to be performed at Islamic meta-frontier due to the only two Islamic DMUs at EAP frontier. Initial presumption is that early adopter region to microfinance will have higher overall, financial, and social efficiency due to learning curve. The summary result is laid out in Appendix 9, with the following findings:

(1) Operational region significantly affect MFI VRS and CRS financial efficiency in both orientations, whereby the trend found is that late adopter tended to have higher financial efficiency: MENA followed by EAP then SA, defying initial presumption albeit small effect sizes ($r = 0.12 – 0.18$).
(2) Result above related to technical inefficiency regarding financial objective in early adopter regions because the rank of 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.

(3) 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 are substantial; ranging from medium to medium large (0.34 – 0.47) showing advantage as microfinance pioneer region in outreach.

(4) 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 yet with miniscule effect size of 0.09.

V.6.3. MFI Efficiency vs MFI Age

The rank assessed in this post DEA analysis are group 1 of young MFIs (1-8 years) and group 2 of mature MFIs (above 8 years). The presumption herein is that experience matters – older MFIs to have higher efficiency due to learning curve. Appendix 10 listed the summary of the analysis results.

Results from global meta-frontier:

(1) Only VRS social efficiency in input-orientated model differs significantly due to MFI age, i.e. if the strategy is to minimise inputs young MFIs exhibit higher efficiency scores compared to mature MFIs yet the effect size is miniscule at 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. However, since the effect size is small this needs to be tested with bigger sample.

(2) Regarding scale efficiency, young MFIs reveal significant higher scale in overall, financial, and social efficiency in output-orientation model, i.e. opposing expectation albeit small effect size ranging from 0.085 – 0.097.

Results from regional and Islamic meta-frontiers:

(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.

V.6.4. MFI Efficiency vs MFI Profit Orientation

Based on existing literatures, the presumption herein is 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 (group 1) to for-profit MFIs (group2) with the summary results is included in Appendix 11.

Findings from global meta-frontier:

(1) Analogous significant differences due to MFI profit-orientation are observed in both orientations 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.
(2) Neither significant differences nor any trend are observed in regard to financial efficiency.
(3) These results concur with abovementioned literatures and presumption regarding social efficiency yet cannot confirm presumption on financial efficiency.

Findings from regional and Islamic meta-frontiers:

(1) Similar significant impact and trend exist in EAP, MENA, SA, and Islamic meta-frontiers for all orientations: 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 but SA meta-frontiers in both orientations and all assumptions with medium effect size (r = 0.21 – 0.41).

(3) Not-for-profit MFIs display higher financial efficiency in all but SA meta-frontier; in EAP, MENA, and Islamic meta-frontiers (with 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 of 0.10 – 0.145. Result from SA confirms the initial expectation yet all the other meta-frontiers show opposing results to presumption from literatures.

V.6.5. MFI Efficiency vs MFI Loan Portfolio Scale

The DMUs in the dataset are herewith classed into three groups based on gross loan portfolio, i.e. group 1 of small scale loan (less than 2 Million USD), group 2 of medium scale loan (2 – 8 Million USD), and lastly group 3 with large scale loan (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' (Armendariz & Szafarz, 2011; James Copestake, 2007a; Mersland & Strøm, 2010). The presumptions established herein are MFIs with large portfolio excel in financial efficiency yet MFIs with small portfolio shine in social efficiency, i.e. the mission drift is expected. The results can be found at Appendix 12 which can be summarised in the following findings.

Findings from global meta-frontier:

(1) MFI loan scale significantly affects VRS and CRS overall and financial efficiency in both orientation strategies: 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.

(2) It is found that significant differences in social efficiency exist due to loan size based on Kruskal-Wallis test in all orientations and all return to scales. However, *linear direction* trend between three groups in analysis could only established 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 for MFIs is only by reducing inputs, MFIs with smaller loan portfolio can reach their outreach objective more efficiently.

(3) Therefore, the existence of mission drift cannot be confirmed in general from the findings; it can only be established in the VRS input-orientation condition.

Findings from regional and Islamic meta-frontiers:

(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-frontier and in CRS overall efficiency in SA meta-frontier albeit in different direction; 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 (negligible effect size *r* of 0.083).

(2) MFI loan scale also significantly affects financial efficiency for both strategies in all meta-frontiers, yet linear patterns can only be established in three frontiers: EAP, MENA, and SA but in also in different directions.

(3) In EAP meta-frontier MFIs with smaller loan portfolio exhibit higher CRS financial efficiency for input-orientated model contrasting prediction, i.e. only in the condition of MPSS and with small effect size of 0.10.

(4) On the other hand, in MENA and SA meta-frontiers MFIs with larger loan portfolio have higher VRS and CRS financial efficiency in all orientations, with small - medium effects in MENA (0.22 – 0.36) and small effects in SA (0.18 – 0.22). The only exception in these is that no linear trend can be established in MENA for VRS input-orientation. These results generally confirm the presumption from literatures.

(5) Concurring with presumption, MFIs with smaller loan portfolio tend to have higher VRS and CRS social efficiency in EAP (small effect size of 0.12 in output-orientation

but medium effect of 0.38 in output-orientation) and in MENA (small to medium effect of 0.19 – 0.33).

(6) Therefore, mission drift phenomenon can only be confirmed in MENA meta-frontier.

V.6.6. MFI Efficiency vs MFI Target Customer

This section tests MFI efficiency differences due to different customer targeting by grouping MFIs into four ranked groups according to average loan balance per customer as percentage of GNI per capita, i.e. group 1 of low end customer (average loan balance of maximum 20% of GNI per capita), group 2 of broad customer (average loan balance between 20% - 149% of GNI per capita), group 3 of high end customer (average loan balance between 150% - 250% of GNI per capita), and group 4 of small business customer (with average loan balance of over 250% of GNI per capita). Thus, linear trend/pattern existence (or lack thereof) from MFIs targeting on poorest borrowers to those targeting better-off poor (the churning poor, occasionally poor and even non-poor segments – as per taxonomy of poverty in Section II.2.2) can be assessed. Initial presumptions instituted herein are 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. The summary of the results can be found in Appendix 13.

Outcomes from global meta-frontier:

(1) The linear trend can be established pertaining VRS and CRS overall efficiency in all orientation models, i.e. MFIs targeting poorer borrowers are found to have significant higher overall efficiency with small to medium effect size (r = 0.23 – 0.30).

(2) The trend also exists whereby VRS and CRS social efficiency in both orientation models are lower as MFIs shifting its target toward well-off poor. The 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.

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

result contrasts that in presumption but only if MFIs operate at their MPSS and the effect is inconsequential.

Outcomes from regional and Islamic meta-frontiers:

(1) MFI target market is found to significantly influence overall, financial, and social efficiencies in all meta-frontiers for both orientations except for CRS financial efficiency in Islamic meta-frontiers. Yet, not all meta-frontier show significant linear trends except in the following meta-frontiers.

(2) VRS and CRS overall efficiency tend to be lower when MFIs shift toward better-off poor in EAP, SA, and Islamic meta-frontiers in both strategy with generally small to medium effect size except for Islamic meta-frontier where the effect size is medium (*r* = 0.28 – 0.34). This shows that overall performance tend to be higher when MFI focus on serving poorer client, especially amongst IMFIs.

(3) In MENA meta-frontier, identical linear pattern can be established for VRS and CRS output-orientated and CRS input-orientated albeit small effect size (*r* = 0.12).

(4) Contradicting presumption, the move of MFIs 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.

(5) 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. This firmly confirms our presumption that targeting poorest segments help MFIs reach to optimally reach their social mission.

V.6.7. MFI Efficiency vs MFI Regulatory Status

The influence of MFI regulatory status on efficiency is analysed herewith by arranging MFIs in two groups: unregulated and regulated MFIs. Based on literatures, initial presumption is that unregulated MFIs excel in social efficiency due to flexibility in operation whilst regulated MFIs lead in financial efficiency due to deposit-taking authorization and due to stricter authority monitoring regarding profit and cost management. Appendix 14 presents the summary of the results.

Findings from global meta-frontier:

- MFI regulatory status is found to significantly affect VRS and CRS overall, financial, and social efficiency in both orientations, i.e. efficiency scores tend to be lower should MFIs is regulated albeit the effect size of the trend is small (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.

Findings from regional and Islamic frontier:

(1) Unregulated MFIs have significantly higher VRS and CRS overall efficiency in EAP, MENA, and Islamic meta-frontiers with 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 of 0.22 – 0.38) and Islamic meta-frontiers (medium effect size of 0.30 – 0.38).

(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.

(4) Regarding social efficiency, a significant linear trend is observed whereby MFIs tend to have higher social efficiency if they are unregulated in both orientations at three meta-frontiers: global (small effect size of 0.12 – 0.14), EAP (with medium to large effect of 0.47 – 0.58), and MENA (with small to medium effect of 0.23 – 0.27).

(5) These results confirm presumption on social efficiency and challenge that of financial efficiency, especially in regard to social efficiency in EAP region.

V.7. Discussions and Conclusion

V.7.1. Discussions

The findings in this study are as follow:

1) This study proposes the use of overall efficiency that is augmented by social efficiency and financial efficiency, calculated with DEA, as three inseparable constructs in measuring MFI performance in regard to its double bottom line objectives. Overall efficiency gives a picture of overall performance of an MFI, whilst social and financial efficiency present the breakdown of MFI performance toward its outreach and financial sustainability objectives, respectively. These three constructs provide a trinity of comprehensive picture to understand MFI performance whereby one is not complete without the other.
2) Moreover, this study proposes the use of SFE matrix to map out the social and financial efficiency measures to enhance the understanding of MFI positioning toward its double bottom objectives and to assist in strategy planning to improve future performance.
3) Although many MFIs in database have strategy focusing toward outreach (social efficiency) or financial sustainability (financial efficiency) as can be seen in SFE matrix, 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.
4) 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.
5) 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.

6) 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.

7) 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.

8) 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.

9) a) It is observed 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.

10) a) Not-for-profit MFIs are found to 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 this study concurs 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.

11) a) It is 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, it can be argued 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, this study 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.

12) 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, identical linear trends are observed 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, it is observed 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. This study thereby argues that MFIs can have more impact by focusing on the poorest of the poor. It confirms Copestake (2007b) that MFIs in dataset that deliberately target well-off poor tend to have lower outreach.

13) a) This study observed that unregulated MFIs have higher overall, financial and social efficiency in all but social efficiency in SA meta-frontiers. It thus confirms 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 findings 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.

V.7.2. 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. 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, and to provide insights in the context for this overall research. 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.

Due to the fairly identical performance between IMFIs and MFIs at the moment and also due to the current limited number of IMFIs in MIX database, the second and third studies will not analyse MFIs and IMFIs separately; they instead will focus on not-for-profit MFIs as this study found that not-for-profit have higher efficiency than its for-profit counterparts and also due to the fact that many MFIs operate globally are in the form or not-for-profit MFIs. Thus enhancing the performance of not-for-profit MFIs will have profound impact to global poverty reduction effort.

V.7.3. Findings on IMFI Performance from Literatures and Field Observations

Performance of IMFIs observed in this research is found to be generally comparable with their conventional counterparts. Whilst quite satisfactory, this finding is unavoidably inadequate; it does not reflect the improvement to the conventional scheme that Islamic microfinance scheme originally intended, i.e. by not charging high interests through supposedly better interest-free financing schemes as discussed in Section II. 4.3. This is particularly observed in the outreach to the borrowers where IMFIs were expected to perform better than conventional MFIs since the absence of high interest should have attracted more borrowers into the scheme. However, it generally still cannot match conventional MFIs performance in this regard. This fact nonetheless requires further investigation, i.e. the possible source in the performance slack of IMFIs.

Indeed, besides lacking in scale efficiency identified from the findings in this study, one answer lies in two of the points criticised from Islamic microfinance practice discussed in Section II.4.4, i.e. the over-reliance to *murābahah* financing mode and the dilution of Islamic financing modes application. In regard to the first point, further literature review related to IMFIs in the dataset, e.g. from The Louis Berger Group (2010), Allen and Overy LLP (2009), Karim et al. (2008), Seibel and Agung (2006), and UN-

HABITAT (2005), indeed described the current dependency upon *murābahah*, especially *murābahah* with *bay' al-muajjal* in Islamic microfinance practices, akin to the case with current practice of Islamic banking (Chong & Liu, 2009). This scheme is used due to its simplicity and its close resemblance to conventional scheme as it is simply a cost-plus-margin trade finance scheme (El Diwany, 2010) but herein lies the problem; as happened in Islamic banking practice, this scheme is often criticised as being too closely related to interest-bearing transactions, i.e. the margin charged in this scheme often too closely mirrors prevailing commercial interest rates thus criticised as interest rates disguised as cost mark-up or as way to circumvent interest-prohibition (Chong & Liu, 2009; N. Karim et al., 2008). Unfortunately, this makes margin charged by IMFIs using this scheme are not cheaper than interest rates charged by conventional MFIs, hence similar problem happened in conventional MFIs to borrowers also happened herein.

Findings from field observations from IMFI practice in Indonesia and from interviews with one global Islamic NGO that operates several IMFIs indeed reveal this fact. In many occasions, this is often happened not by design; since the funding source for IMFIs from Islamic banking or donors are still limited or insufficient, many IMFIs in developing countries must resort to conventional banking for funding source thereby forcing them to charge margin according to the interest rates charged by the banks. This problem has occurred since the beginning of Islamic microfinance (Abdul Rahman, 2007; Wilson, 2007) that regrettably suffered to date. This has inevitably instigated rejection from pious borrowers due to margin perceived as too high and also due to 'impure' funding source from interest-bearing loans.

The dilution of *murābahah* practice also compounded this effect. From the interviews, field observations, and literatures, it is found that the in kind transfer that should have been used in this scheme to avoid misuse of the financing have often been changed to cash transfer due to simplification of method and due to avoiding perceived complication, as noted in Ahmed (2002). Consequently, this caused problem such as loan misuse, which is supposed to be avoided by IMFIs, to also occur. As a result, problems and weaknesses in conventional microfinance practice also happen in IMFIs, making intended improvement non-existent. Thus, IMFIs are encouraged to exploit other schemes that are available so that performance improvement as intended can be achieved.

In summary, these facts have also served as evidence that the problem in Islamic microfinance is also largely due to agency problem.

Chapter VI: Loan Methodology and Not-For-Profit MFI Efficiency

VI.1. Study Background

This chapter describes the second from three interrelated microfinance efficiency studies in this research. It seeks to observe the relationship of MFI loan methodology to MFI efficiency, with special focus on not-for-profit MFIs globally. As per discussion in Section II.3.2.4, a trade-off is perceived in MFI double bottom objectives whereby outreach is attained at the expense of financial sustainability, which in turn instigated two extremes in microfinance approaches, i.e. institutionalist approach focusing on sustainability and welfarist approach emphasising on outreach (Robinson, 2001). Alternatively, Simanowitz (2007) suggested a middle path where trade-off can and should be managed. In conjunction to this middle path, the first study in Chapter V, the concise format of which had been published as Widiarto and Emrouznejad (2015), argues that microfinance objectives are more appropriately perceived as relative measures; it thus empirically observed using non-parametric DEA that these dual objectives can be pursued concurrently by best-practice MFIs in a region/frontier exercising appropriate strategy. Likewise, Miyashita (2000) and Cull et al. (2007) stresses on the importance of MFI strategy formulation to manage this trade-off.

The central strategy herein as per Cull et al. (2007) is credit design, i.e. an appropriate lending methodology. Mainstream financial institutions reluctance to finance the poor is due to *ex ante* adverse selection and *ex post* moral hazard (Hermes & Lensink, 2007). Grameen Bank Bangladesh thus pioneered the innovative group lending scheme that mitigates these risks through joint liability, whereby a mutual and morally binding guarantee in lieu of collateral exists herein via a peer guarantee mechanism (Varian, 1990). It has since replicated globally and spurred microfinance growth, as it mitigates information asymmetry thus circumvents adverse selection and moral hazard problem (Godquin, 2004). Nevertheless, despite many advantages which prompted group lending to be regarded as the best loan method for microfinance scheme e.g. in Armendariz de Aghion and Morduch (2005) and (Kono & Takahashi, 2010) , there are many weaknesses found by observers in the practical level as per discussion at Section II.3.3.1. One main weakness herein is that due to dynamic incentive, the poorest are often found to be left out in group formation by other members due to risk making group scheme often cannot touch the poorest (Morduch, 1999).

On the contrary, Indonesia's BRI Unit Desa, one of the biggest MFIs in the world, takes more commercial approach and employs individual lending requiring collateral (Helms, 2006) akin to that in mainstream financial institutions. Yet, the twist herein is that risks are assessed not by financial documents; rather, by unorthodox methods ranging from visiting applicants' businesses and homes to loan guarantee and character reference from local village committee (Armendáriz de Aghion & Morduch, 2000; Churchill, 1999), coupled with dynamic incentives as guarantor exercises social pressure for timely repayment (Jaunaux & Venet, 2009). Individual lending is observed to exhibit many advantages, e.g. lower transaction costs, security, and loan term flexibility. Thorough comparison between group and individual lending are discussed in Dellien et al. (2005), Lehner (2009), Madajewicz (2011), and Giné and Karlan (2014).

Due to these advantages, many advocated the use of individual lending in microfinance, e.g. as offering to retain clients with growing businesses (Madajewicz, 2011), as more suitable offering in relatively industrialized area and in transition economies (Armendáriz de Aghion & Morduch, 2000). Indeed, many MFIs had added individual loan or switched completely into individual loan. However, it is found to have lower outreach and also open to mission drift as per discussion in Section II.3.3.3.

Section II.3.3.3 discusses another widely-used loan method in microfinance, especially in Africa and Latin America is village banking loan, which extent credits and savings through community-managed associations at village level with 30 – 50 members; aiming to become independent self-sustaining financial providers in three years. Whilst it is associated with poorer borrowers and lower average loan borrowers, but its costs is found to be higher than that in group lending due to self-management whilst it also exhibits limitation of group lending.

Therefore, as all methods are not without setbacks, it is intriguing to analyse which loan method that is relatively best to pursue dual objectives, i.e. one that can deliver relatively higher overall, financial, and social efficiency. Furthermore, it is interesting to observe whether there is a method that can perform best in *all* regions, as it is often generalised or implied in existing literatures. Empirical evidence is thereby indispensable considering that different regions face different demographics and, from institutional theory perspective, MFIs must adapt to the rules and belief systems in their environment to survive (Scott, 1995). Different demographics and geopolitics may affect suitability of a loan method; similarly, other factors e.g. interest rates, borrowings, donations, and MFI characteristics may also influence performance differently. If these are the case, then analysis should be performed in each region to safely form conclusion and suggestion to the MFI stakeholders in each region.

The rest of this chapter is organised as follow: Section VI.2 explores the research questions in this study in more detail that will be accompanied by the study aims. Section VI.3 briefly presents the DEA specifications along with DEA model and its input – output selection used in first stage plus second stage Tobit regression model. The dataset is explained in section VI.4, which is subsequently followed by first and second stage results in section VI.5 and VI.6, respectively. Section VI.7 summarises this chapter with conclusions and discussions of the results.

VI.2. Research Questions, Research Aims, and Research Contributions

This study seeks to explore the relationship between loan methods – MFI performance, more specifically, between loan methods and MFI overall, financial, and social efficiency, to subsequently determine a method or combination of method that can deliver the relatively best performance. It initially assesses these MFI efficiency in six regions globally, i.e. Africa, East Asia and The Pacific (EAP), Eastern Europe and Central Asia (EECA), Latin America and The Caribbean (LAC), Middle East and North Africa (MENA), and South Asia (SA) separately, thereafter examines the significance relationship of the efficiency scores to the loan methods and the ranking of the three loan methods and their combinations in relation to efficiency in each region.

Three research questions explored in this study are therefore firstly, whether loan methods have different impact to MFIs' overall, financial, and social efficiency in different regions. Existing MFI literatures on loan methods had either covered each loan type in global scope or only in some selected regions. Yet, due to different geopolitical and demographics facing each region, results may be different for different region. As part of this, this study seek to understand the impact of combination of these three loan methods to overall, financial, and social efficiency, i.e. if an MFI offers two of three of this methods in its loan offerings to borrowers. Thus far, there have been no existing MFI literatures that have recorded the empirical evidence of the impact of loan combination to efficiency in each region mentioned above.

Secondly, this study seeks to observe whether there exists a method and/or method combination that can offer higher overall, financial, and social efficiency in all regions. As previously, the presumption in this study is that differences in demographics may affect appropriate loan method, i.e. concept of best loan method is argued to be relative rather than absolute, as it is the case with performance concept itself. Consequently, separate assessments of best method in different regions are proposed herein. As in Section VI.1, existing MFI literatures to date have suggested a particular method or two as the ideal method to be offered in microfinance programme, yet there have been no studies so far as offering empirical evidence in each region above.

The third question to be observed in this study is whether factors such as interest rates, borrowings, donation, portfolio at risk and others have different impact to MFI efficiencies in the six regions above. The first study in the previous chapter have observed different impact to MFI performance from several factors in three regions observed in 2009-2010 period, so the second study will broaden the period observation to 2003-2012 period, albeit unbalanced, and will observe more factors that have been mentioned in literatures as to having significant impact to MFI performance.

Therefore, the first objective of this study is to establish empirical evidence to current understandings gain from existing literatures that (1) individual lending has positive effect to financial efficiency but negative effect to social efficiency, (2) group lending and village banking lending have opposite effects to social and financial efficiency in comparison to individual lending; including herewith is establishing empirical evidence of impact of the combination of these three lending methods to MFI overall, financial, and social efficiency. The second objective is to propose empirical evidence regarding the ranking of loan method or combination of methods that can offer higher efficiency in each region observed.

Thirdly, the study explores the impact of these loan methods and combinations plus other factors specifically to not-for-profit MFIs. This focus is in line with the main focus of this overall research, i.e. on not-for-profit MFIs as it is regarded by many as best microfinance provider, e.g. Dichter (1996) and Haq et al. (2010). Moreover, the focus herewith is not only NGO-MFI, but also extended to those beyond NGOs which has not-for-profit orientation in their charter, e.g. credit union/ cooperatives, non-bank financial institutions (NBFI) or other formats. The first study in Chapter V also observed that not-for-profit MFIs showed generally higher efficiency in EAP, MENA and SA regions, as had been published as Widiarto and Emrouznejad (2015).

Fourthly, this study aims to further DEA as an adept method to measure relative performance vis-à-vis social, financial, and overall efficiency of MFI, and at the same time to propose an advancement to the previous study in Chapter V by proposing hyperbolic non-oriented DEA as a proficient alternative in MFI efficiency measurement, due to its ability to assess MFI performance in the situation whereby input reduction and output expansion are pursued concurrently. This model is explored at Section VI.3.1.1.

The fifth aims pursued by this study is to form a basis of policy recommendation to MFI management and its other stakeholders in regard to suitable loan methodology that can boost efficiency in its particular region of operation.

Finally, this study aims to make contribution to the literatures of both DEA application and MFI performance studies. Specifically, the contribution of this study are three folds, i.e. (1) contributing regional-based evidence to microfinance and DEA literatures regarding social and financial efficiency and their relationship with loan methods; (2) contributing to literatures in the use of hyperbolic non-oriented DEA in microfinance performance assessment, which have not been utilised thus far; (3) constructing basis for policy recommendation to MFIs in different regions.

VI.3. Methodology and Input-Output Specifications

VI.3.1. Methodology and Assessment Approach

As in the first study, the MFI performance is assessed in three efficiency specifications, i.e. overall efficiency as the general measure of MFI overall performance that is enhanced by measures of social and financial efficiency to represent MFI dual objectives. These efficiencies will be measured in the first stage whilst the second stage observes the significance of the relationship between MFI efficiency and loan methods, and also between MFI efficiency with other variables.

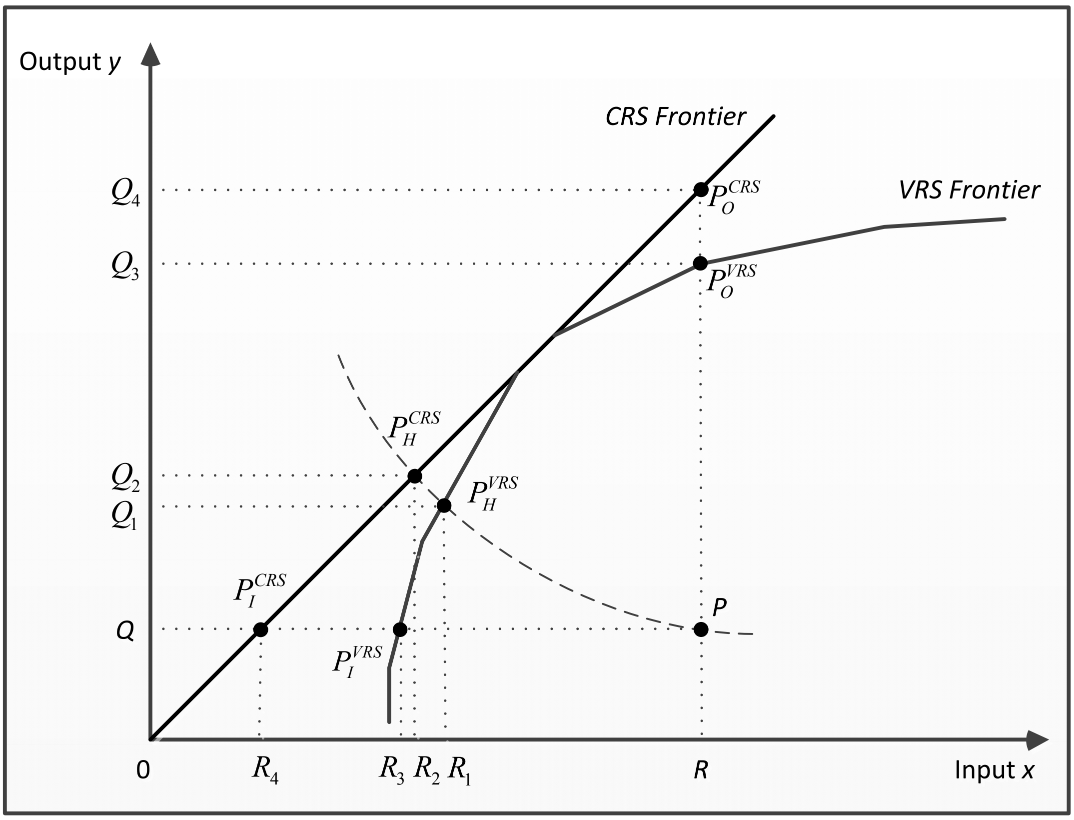
VI.3.1.1. Methodology in First Stage: Hyperbolic Non-oriented DEA

In an effort to propose a more realistic model in the MFI efficiency, for the first stage analysis this study proposed advancement to the basic DEA models used in the first study in Chapter V, i.e. hyperbolic non-oriented DEA model.

The basic DEA models are built upon output orientation or input orientation approaches, whereby the former assesses maximum possible proportional increase of outputs provided all inputs remain fixed whilst the latter measures maximum proportional saving of inputs whilst keeping output constant. This is also manifest in the use of DEA in microfinance studies, some of which are highlighted at Table 4.1 in Chapter IV. However, it is suggested herein that forcing all MFIs to be assessed by selecting merely one strategy to boost efficiency, either input-minimising or output-maximising, may not be practical; a DMU such as MFI may have to both attempt to maximise output and to minimise inputs concurrently to boost efficiency, e.g. an MFI may have to expand the number of borrowers (output) whilst also minimising operating expense (input) simultaneously to reach higher efficiency.

Moreover, some of the early DEA – microfinance studies uses solely CRS assumption in their analysis. Yet again, it is argued herein that it is unrealistic as CRS assumption captures DMU performance (in this case MFIs' performance) at their MPSS whilst not all MFIs in analysis operate at their MPSS. Moreover, MFIs do not have identical size, i.e. some MFIs have very big operational scale, such as BANCOSOL in Bolivia, whilst many others have very small operational scale, such as Farz Foundation in Pakistan. Thus, comparing MFIs with massively different scale size such as these will not be appropriate. Thus, it is argued that VRS assumption is intuitively more appropriate to be applied since each MFI will only be measured against similarly-sized MFIs as differences in MFIs' operational sizes may affect MFIs' efficiency. Under VRS assumption MFIs are allowed to demonstrate different returns to scale.

Figure 6.1: Hyperbolic Non-orientated Technical Efficiency



Source: Färe et al. (1994), redrawn and modified by author

Therefore, this study proposes the use of hyperbolic non-oriented DEA model (Färe et al., 1985, 1994) under VRS condition. This model offers more flexibility as it allows equiproportional output expansion and input contraction concurrently. This model is illustrated in comparison to both input- and output-orientation approach in Figure 6.1. Suppose in a single input – single output environment, a DMU *P* have input – output vector (R, Q). The VRS frontier herein is depicted as piecewise linear frontier as per frontier constructed in DEA.

In input-orientated approach, the TE of DMU *P* will be assessed from its performance against its benchmark at $P_I^{VRS}(\mathrm{R}_3,\mathrm{Q})$ based on VRS assumption or at $P_I^{CRS}(\mathrm{R}_4,\mathrm{Q})$ under CRS, whereby equiproportionate reduction of input is sought to reach optimum input level. On the other hand, if output-orientated strategy is sought then the TE of DMU *P* is measured from its performance relative to its benchmark at $P_O^{VRS}(\mathrm{R},\mathrm{Q}_3)$ under VRS or at $P_O^{CRS}(\mathrm{R},\mathrm{Q}_4)$ under CRS.

In hyperbolic non-orientated approach, reduction of input pursued by DMU *P* is matched by equiproportional increase of output, thus its benchmarks now are projected toward VRS and CRS frontiers in a hyperbolic pathway to $P_H^{VRS}(\mathrm{R}_1,\mathrm{Q}_1)$ under VRS and $P_H^{CRS}(\mathrm{R}_2,\mathrm{Q}_2)$ under CRS, i.e. the projection of ideal performance for DMU *P* under each return to scale assumption in a non-oriented approach. The model can be formulated in the following:

$$\min \theta \text{ or } \max \phi \tag{6.1}$$

subject to:

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

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

$$\sum_{j=1}^{n} \lambda_j = 1, \qquad j = 1,2,\ldots,n$$

$$\lambda_j \ge 0$$

$$\phi = 2 - \theta$$

$$\theta, \phi \ge 0$$

in which x_{ij} and y_{rj} are the *i*th input of *j*th DMU and *r*th output of *j*th DMU respectively. θ is the input-minimising efficiency for the particular DMU_0 whilst ϕ is output-maximising efficiency for this DMU_0. Constraint $\phi = 2 - \theta$ is the first-order linear approximation of the constraint $\theta^*\phi = 1$, i.e. a tangent line to the $\theta^*\phi = 1$ hyperbola at any point. Convexity constraint for λ_j, i.e. $\sum_{j=1}^{n} \lambda_j = 1$, represents VRS assumption and ensures DMU to be assessed with similarly-sized DMUs in dataset.

This study argues that findings on loan method that offers MFIs a higher efficiency in each regional frontier are more beneficial for policy recommendation. Thus, the hyperbolic non-oriented DEA model above is utilised to assess MFI efficiency in six regional frontiers separately to obtain regional efficiency scores relative to regional benchmark. Indeed, the first study had shown different results for different regions in the short observation period. Due to unbalanced data available from MIX Market, a meta-frontier approach is utilised in each region, whereby all unbalanced data from all MFIs in all fiscal year in one region are assessed against single meta-frontier in that respective region thus making MFIs' performance in different fiscal year comparable, similar to the treatment at the second stage analysis of the first study in the Chapter V. This is thus far the first MFI efficiency study that utilises hyperbolic non-oriented DEA model with meta-frontier approach in six regions globally.

VI.3.1.2. DEA Assessment Approach

As discussed in Section IV.3 and Section V.3.2.2, production approach is used herein to maintain homogeneity in analysis, as with many DEA – microfinance studies, e.g. Fluckiger & Vassiliev (2007), Gutiérrez-Nieto et al. (2007), Gutiérrez-Nieto et al. (2009), Widiarto & Emrouznejad (2015) and Haq, Skully, & Pathan (2010).

VI.3.1.3. Methodology in Second Stage: Tobit Regression

In the post DEA analysis at the second stage, regression analysis is used to observe the relationship of loan methods and efficiency rank of loan methods in each frontier or region. Due to the magnitude of efficiency scores of between 0% to 100% or 0.00 to 1.00, Tobit regression is used since this method is suitable for condition where the dependent variable is either left-censored, right-censored, or both. In this case, technical efficiency scores as the dependent variable is censored left and right between 0% and 100%. The complete Tobit regression model utilised at the second stage analysis is as follows:

$$
\begin{aligned}
TE_i = {} & \alpha + \beta_1 Borrowing_i + \beta_2 Borrowing_i^2 + \beta_3 Donationall_i + \beta_4 Donationall_i^2 + \beta_5 CPB_i + +\beta_6 PAR30 \\
& + \beta_7 PAR90 + \beta_8 Yieldreal_i + \beta_9 Yieldreal_i^2 + \beta_{10} Individual_i + \beta_{11} Individual_i^2 + \beta_{12} Group_i + \beta_{13} Group_i^2 \\
& + \beta_{14} Village_i + \beta_{15} Village_i^2 + \gamma_1 GroupDummy_i + \gamma_2 VBankDummy_i + \gamma_3 IndivGroupDummy_i \\
& + \gamma_4 IndivVBankDummy_i + \gamma_5 GroupVBankDummy_i + \gamma_6 AllMethodDummy_i + \gamma_7 Bank_i \\
& + \gamma_8 CUCoop_i + \gamma_9 NBFI_i + \gamma_{10} OtherForm_i + \gamma_{11} MFIAge_i + \gamma_{12} Regulation_i
\end{aligned}
$$

$$
TE_i = \left\{ \begin{array}{l} TE_i^* \text{ if } 0 < TE_i^* < 100 \\ 0 \text{ if } TE_i \leq 0 \\ 100 \text{ if } TE_i \geq 100 \end{array} \right\}
$$

Three basic loan methods are included in the Tobit regression model above as predictor variables (Individual, Group, and Village) in original and squared forms and as categorical variables in the form of six dummy variables representing seven loan method combinations as follow:

1. Individual loan
2. Group lending loan
3. Village banking loan

4. Combination of individual and group lending loan (referred to herein as loan combo 4)
5. Combination of individual and village banking loan (i.e. loan combo 5)
6. Combination of group and village banking loan (i.e. loan combo 6)
7. Combination of all three loan methods (i.e. loan combo 7)

The seven loan methods and combinations above are included as six dummy variables with individual loan as the base category.

The inclusion of loan methods in the Tobit regression model as scale predictor variables and as categorical dummy variables are due to different objectives that are aimed to be achieved in this study. Three basic loan methods are included as scale variables, in both original and squared forms, to observe their relationship to MFI efficiency, i.e. whether they exhibit linear or quadratic relationship to efficiency. The results are expected to provide regional-based empirical evidences to each loan method's influence to efficiency, as discussed at length at Section II.3.3. More specifically, these variables strive to observe the relationship of each loan method to overall, social, and financial efficiency. However, in MENA village banking was dropped from model as there is only one DMU using this in combination method.

On the other hand, the inclusion of six dummy variables as categorical variables representing seven loan methods above strive to answer the main research questions in this study, i.e. which loan method or loan method combination that on average deliver higher efficiency in each region. In other words, it strives to provide regional-based empirical evidences to different claims in studies concerning loan method(s) that provide higher outreach and financial sustainability, or the answer to the question of "best loan method". Thus, an efficiency rank of loan methods aimed to be constructed from these six dummy variables with individual loan as the base category against which other methods are assessed. However, coefficients from village banking loan dummy in EECA and loan combo 7 dummy in MENA and SA region will be disregarded from the ranking, even if they are significant, since they were only used by one DMU. Likewise, the coefficient of loan combo 6 and loan combo 5 dummies in Africa and EAP, respectively, will also be disregarded from the rank since they are only used by three DMUs.

Additionally, it also includes factors whose relationship to efficiency is noteworthy to be observed, as follow: borrowings, total donation, cost per borrower (CPB), portfolio at risk 30 days, portfolio at risk 90 days, real yield on gross portfolio, and MFI characteristics (MFI age, legal status, and regulation status). The descriptions of these additional variables are as follow:

- **Borrowings**

  As per MIX definition, this variable represents the commercial lending that MFI borrowed from financial institutions and other institutions. As many MFIs sourced their funding from borrowings for their operation, many MFIs in various legal formats in developing countries rely on commercial borrowings as their source of fund, e.g. MFIs in Indonesia visited after first study for observation. Thus, it may be interesting to see its relationship with financial and overall efficiency. Hereby, the initial presumption is that this variable has positive relationship with overall and financial efficiency.

- **Total donation**

  Total donation used in the model is a sum of 'donation' and 'donated equity' in MIX database. Donation denotes the amount of cash donation received by MFI and donated equity represents in-kind donation and other non-cash donation intended to strengthen MFI equity. The intention to include total donation in the Tobit regression model is to use it as one proxy of subsidy, and to observe whether subsidy in the form of donation really help DMUs in their efficiency, especially financial efficiency (sustainability) as suggested in literatures, such as Hudon and Traca (2011). Moreover, since many not-for-profit MFIs are relying on donation, e.g. those set up by relief organisations, it would be beneficial to examine its influence to their efficiency. There are different kind of subsidy received by MFIs, of which donation is one of them. Another kind of subsidy is softer loan, i.e. borrowings with softer term or reduced special interest rates. However, this variable is difficult to observe from MIX database. Further research into this matter is needed. The initial presumption is that total donations have positive relationship with overall, financial, and social efficiency.

- **Portfolio at risk 30 days (PAR 30) and Portfolio at risk 90 days (PAR 90)**

  In MIX database, portfolio at risk (PAR) portrays the percentage of total loan outstanding at risk of default due to having one or more instalments in arrears more than 30 days (for PAR 30) or more than 90 days (for PAR 90). PAR 30 was included as one of the inputs in the first study, but it is excluded in the first study herein due to the fact that it is not completely in control of MFI management and findings from interviews with one global IMFI and several MFIs and IMFIs in Indonesia showed that, due to MFI business nature which caters to the poor segment, PAR 30 is actually quite common and not of major concern for MFIs with focus on poor borrowers since many are usually repaid after it passed the 30 days mark; however, PAR 90 is more concerning to these MFIs since loans in arrears from more than 90 days is usually turned into non-performing loans.

  Therefore, these were included instead in the Tobit regression model to observe its relation to efficiency, i.e. whether DMUs with higher efficiency scores are associated with lower risk or higher risk. Thus, initial conjecture for PAR 30 cannot be formed; on the other hand, the presumption can be established that DMUs with high efficiency scores are associated with low magnitude of PAR 90.

- **Real yield on gross portfolio**

  This variable represents interest rate charged by MFIs to its borrowers, which includes fee or margin charged by Islamic MFIs in lieu of interest. Cull et al. (2007) stated a curvilinear relationship of this variable to MFI performance. Therefore, this variable is entered in Tobit regression in its original form and in squared term to observe curvilinear relationship to efficiency measures that may exist. Based on literatures, our initial presumption is that this variable will have negative and convex relationship with overall and financial efficiency, and negative concave relationship with social efficiency.

- **MFI age, legal status, and regulatory status**

  As in the first study, the relationships of these MFI characteristics to MFI efficiency are intriguing to be assessed. Especially since this study is focusing on not-for-profit MFIs and involving wider scope and longer observation periods. The initial assumption based on previous findings therefore is that MFI age has positive relationship with financial efficiency but negative relationship with social efficiency (due to younger MFIs are idealistic and older MFIs faces the option of 'scaling-up'). In reference to MFI regulatory status, the assumption herewith is that unregulated MFIs will show higher social efficiency whilst regulated ones will demonstrate higher financial efficiency. Thus, in order to observe the influence of these categorical variables to MFI efficiency, the last two dummy variables, i.e. MFIAge and Regulation, are included in the Tobit regression.

Similarly, five MFI legal formats are included in Tobit regression model as four dummy variables (Bank, CUCoop, NBFI, and Other) with NGO as the base category against which the others are assessed. Five MFI legal formats assessed in this study are NGO, bank, credit union/cooperative (CU/Coop), non-bank financial institution (NBFI) and other format (including but not limited to government poverty alleviation team, government foundation, rural bank, etc.). Five rural banks in the dataset, one in EAP and four in LAC, were grouped along with other MFI formats in the 'Other' category.

The inclusion of these four categorical dummy variables is to construct MFI legal format rank in relation to efficiency, i.e. in seeking an answer to the question of MFI format that can provide higher efficiency in each region observed. This is to provide regional-based empirical evidence to the notion that NGO is the best provider for microfinance, which is stated in many microfinance literatures. Consequently, the a priori notion for MFI legal status as in existing literatures is that NGO will show higher efficiency in all measures. Yet, the assumption regarding ranking of other legal status in terms of ability to deliver higher efficiency cannot be established.

It should be noted, however, that due to the data limitation, dummy variable for "Bank" and for "Other" in Africa and MENA, respectively, will be disregarded from rank construction, even if it is significant due to limited number of DMUs in these categories.

Borrowings and total donations are assigned in both linear and squared format to analyse possible linear and curvilinear relationship to efficiency. Similarly, real yield on gross portfolio as a proxy for interest rates is also set in both linear and squared format to observe linear or curvilinear relationship recorded in the literatures (Cull et al., 2007). Portfolio at risk 30 days (PAR 30) and portfolio at risk 90 days (PAR 90) are included to examine relationship of loans in arrears to efficiency.

All monetary data in the dataset are presented in US Dollar hence comparable. As in the first study, mean normalization as per Sarkis (2007) is used in DEA analysis in the first stage as inputs and outputs data have very different magnitude, i.e. by dividing each value in a variable with the mean of that variable. The formula can be referred to in equation (5.2) in Section V.4.

In the second stage analysis, all independent variables data are centered to their mean to make interpretation of the coefficients easier, especially for coefficients of squared independent variables; this is executed by subtracting all data in a variable with their mean, thus placing zero at the centre of the data range. Numerical data are represented in unit of USD 100,000 to simplify coefficient analysis.

VI.3.2. DEA Input – Output Selection

The DEA model in this study uses three inputs and three outputs, which is a modification of the model used in the first study; three inputs represent capital and labour in production, i.e. assets (A), operational expenses (O), and employee (E), whilst one output represents sustainability, i.e. interest revenue (Ir), and two outputs represent outreach, i.e. inverse of average loan balance per borrower over GNI per capita (I) and borrower (B). Table 6.1 presents these variables along with their definition from MIX.

The modifications from the model used in the previous study are intended to simplify the DEA model so that it will have more discriminatory power, and also in order to construct a model that better representing inputs and outputs that are in control of MFI management. The alterations are as follow:

Table 6.1: DEA Input – Output Variables – Study II

Inputs	Initial	Definition	Usage in literatures	Unit
Assets	A	Asset needed in transformation process	Berger and Humphrey (1997), Bassem (2008), Kipesha (2012) and Gutierrez-Nieto et al. (2009)	USD '000
Operating Expense	O	Expenses related to operations, e..g. personnel expenses, administrative expenses.	Gutiérrez-Nieto et al. (2007), Berger and Humphrey (1997), Gutiérrez-Nieto et al. (2009), Hassan and Sanchez (2009) and Athanassopoulos (1997)	USD '000
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), Berger and Humphrey (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Kipesha (2012), and Haq et al. (2010)	Numerical

Outputs	Initial	Definition	Usage in literatures	Unit	MFI Objective (Efficiency) Represented
Interest Revenue	Ir	Revenue from loan portfolio, including margin rate charged in Islamic microfinance loan.	Modification from literatures. Many literatures, e.g. Gutiérrez-Nieto et al. (2009) and Hassan & Sanchez (2009) use financial revenue.	USD '000	Sustainability (Financial Efficiency)
Inverse of Average Loan Balance (standardised over GNI per Capita)	I	Inverse form of average loan balance standardised over gross national income (GNI). Standardised to represent purchasing power and to remove currency value differences. Used in inverse format as output	Modification from literatures. Gutiérrez-Nieto et al. (2009) use average loan borrower as index together with number of borrower.	%	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.	Modification from literatures. Most literatures use number of women borrowers, e.g. Cull et al. (2007) and Nghiem et al. (2006).	Numerical	Outreach (Social Efficiency)

- **The exclusion of portfolio at risk 30 days (PAR 30) from input variables.**

  PAR 30 is not included as input in the DEA model in this study as it is not entirely in management control and as it is found from interviews with management of a global MFI and several MFIs and IMFIs in Indonesia that PAR 30 is not a major concern to MFIs due to its operational nature. Since MFIs deal mostly with small-scale entrepreneurial effort from the poor segment, the loan repayments are often in arrears for 30 days. On the other hand, the portfolio at risk 90 days (PAR 90) is more concerning for MFIS, as it represents the percentage of loan portfolio that is in arrears for 90 days or more. Therefore, PAR 30 is now included as one of influencing factors to be assessed in the second stage analysis along with PAR 90 to see how these variables can influence MFI efficiency.

- **The substitution of financial revenue with interest revenue as output variable that represent financial sustainability.**

Interest revenue (Ir) is used herein as output representing financial sustainability replacing financial revenue due to the main focus of this study which is to analyse the relationship of selected loan methodology and not-for-profit MFI efficiency. Thus, the best variable to represent revenue as output from MFI transformation process which is related to loan methodology is interest revenue, since financial revenue includes revenue from other financial assets as well. Interest revenue variable includes 'margin' or profit-sharing charged in Islamic microfinance schemes in lieu of interest.

VI.3.3. DEA Model Specifications

Parallel with the first study, this study uses different input-output specifications in assessing overall, social, and financial efficiency which is mnemonically termed using input-output initials in Table 6.2.

Table 6.2: DEA Specifications

DEA specifications (Mnemonic)	Efficiency specifications	Input variables	Outputs variables
AOE-IrIB	Overall efficiency	· Assets (A) · Operating expenses (O) · Employees (E)	· Interest revenue (Ir) · Inverse of Average loan balance per Borrower over GNI per capita (I) · Number of borrowers (B)
AOE-Ir	Financial efficiency	· Assets (A) · Operating Expenses (O) · Employees (E)	· Interest revenue (Ir)
AOE-IB	Social efficiency	· Assets (A) · Operating Expenses (O) · Employees (E)	· Inverse of Average loan balance per Borrower over GNI per capita (I) · Number of borrowers (B)

VI.4. Dataset

Dataset used in this study is unbalanced data sourced from MIX database of 628 not-for-profit MFIs in 87 countries for the period of 2003-2012 in six regions globally: Africa, EAP, EECA, LAC, MENA and SA. This is due to limited availability of balanced data in MIX for some regions that have all variables needed. Meta-frontier approach is utilised to enable comparison between data from different fiscal year in a region, i.e. all unbalanced MFI data in each region are assessed together against single meta-frontier hence comparable. Due to the use of meta-frontier approach, the total DMU assessed in this study becomes 1461 DMUs.

Figure 6.2: MFI Grouping by Regions

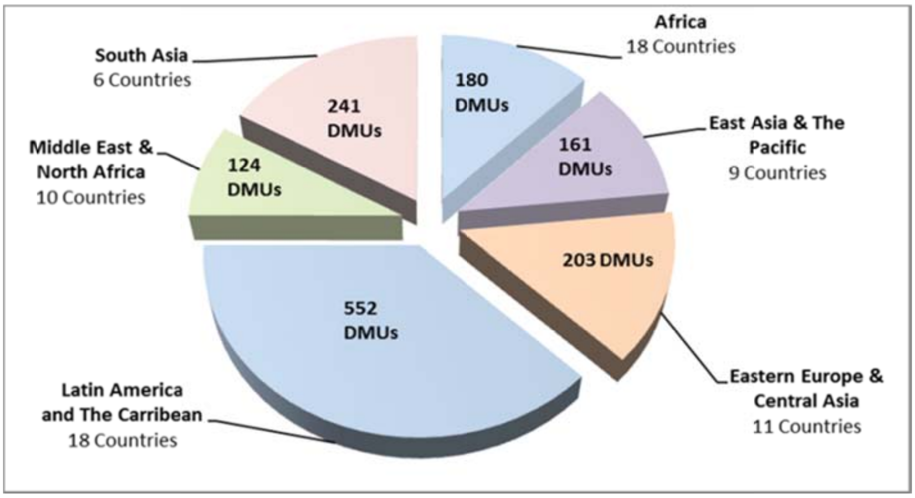


Table 6.3 presents the summary of DMUs by loan method for each region, whereby only in SA region that group lending scheme is still used by majority of DMUs in dataset; in EECA and LAC vast majority of DMUs in dataset employ individual loan method. Conversely, majority of DMUs in dataset for Africa, EAP and MENA regions utilise a combination of individual and group loan. Thus, group loan is no longer dominating microfinance practice as it were in the early growth of microfinance. Even in SA, individual loan scheme becomes the second widely-used method among DMUs in dataset.

Table 6.3: Summary of Grouping of MFI in Dataset by Loan Method

Loan Method & Combinations	Africa		East Asia & The Pacific (EAP)		Eastern Europe & Central Asia (EECA)		Latin America & The Caribbean (LAC)		Middle East & North Africa (MENA)		South Asia (SA)	
	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%
Individual Loan	26	14.44	45	27.95	132	65.02	202	36.59	38	30.65	67	27.80
Group Loan	12	6.67	53	32.92	8	3.94	12	2.17	6	4.84	90	37.34
Village Banking Loan	11	6.11	0	0.00	1	0.49	15	2.72	0	0.00	30	12.45
Individual & Group Loan	90	50.00	60	37.27	53	26.11	114	20.65	79	63.71	37	15.35
Individual & Village Banking Loan	9	5.00	3	1.86	5	2.46	66	11.96	0	0.00	11	4.56
Group & Village Banking Loan	3	1.67	0	0.00	0	0.00	4	0.72	0	0.00	5	2.07
All Methods	29	16.11	0	0.00	4	1.97	139	25.18	1	0.81	1	0.41
	180	**100.00**	**161**	**100.00**	**203**	**100.00**	**552**	**100.00**	**124**	**100.00**	**241**	**100.00**

Table 6.4: Further MFI Groupings by MFI Characteristics

MFI Classifications	Africa		East Asia & The Pacific (EAP)		Eastern Europe & Central Asia (EECA)		Latin America & The Caribbean (LAC)		Middle East & North Africa (MENA)		South Asia (SA)		Total Dataset	
	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%	No of DMU	%
By MFI Legal Status:														
NGO	96	53.33	123	76.40	58	28.57	433	78.44	102	82.26	211	87.55	1,023	70.02
Bank	1	0.56	-	-	-	-	4	0.72	-	-	-	-	5	0.34
Credit Union / Cooperative	72	40.00	17	10.56	87	42.86	89	16.12	-	-	17	7.05	282	19.30
NBFI	11	6.11	7	4.35	58	28.57	26	4.71	20	16.13	8	3.32	130	8.90
Other	-	-	14	8.70	-	-	-	-	2	1.61	5	2.07	21	1.44
Total	**180**	**100.00**	**161**	**100.00**	**203**	**100.00**	**552**	**100.00**	**124**	**100.00**	**241**	**100.00**	**1,461**	**100.00**
By MFI Age:														
Young	38	21.11	45	27.95	77	37.93	38	6.88	34	27.42	54	22.41	286	19.58
Mature	142	78.89	116	72.05	126	62.07	514	93.12	90	72.58	187	77.59	1,175	80.42
Total	**180**	**100.00**	**161**	**100.00**	**203**	**100.00**	**552**	**100.00**	**124**	**100.00**	**241**	**100.00**	**1,461**	**100.00**
By Regulation Status:														
Unregulated	49	27.22	109	67.70	68	33.50	500	90.58	62	50.00	95	39.42	883	60.44
Regulated	131	72.78	52	32.30	135	66.50	52	9.42	62	50.00	146	60.58	578	39.56
Total	**180**	**100.00**	**161**	**100.00**	**203**	**100.00**	**552**	**100.00**	**124**	**100.00**	**241**	**100.00**	**1,461**	**100.00**

Figure 6.2 and Table 6.4 present groupings based on region, legal status, age, and regulatory status of 1461 MFIs in the dataset.

As previously mentioned in Section I.1.5.3 and IV.4, a disclaimer should also be made in the interpretation of the analysis results herein. The results of the analysis herein should be interpreted with consideration to the limitation arising from the nature of the voluntary data in MIX Market. Yet, since MIX Market is considered to be the best data clearinghouse for microfinance at the moment, the dataset utilised herein is perceived to be the best sample available in regard to inputs and outputs considered herein for the regions and periods analysed.

VI.5. First Stage: Non-oriented Hyperbolic DEA Meta-frontier Approach

Summary of DEA results in the first stage is presented in Table 6.5 and 6.6. Utilising meta-frontier approach in each region as in the second stage of the first study, all DMUs from all periods are assessed against single meta-frontier hence all comparable.

This study found that, whilst mean overall and financial efficiency in all meta-frontiers are generally above 60% with almost all exhibit first quartile scores higher than 50%, the lowest financial efficiency in Africa, EECA, LAC, and SA to be below 10% with the lowest being in Africa of 0.24%. These certainly show a very wide gaps between the most- and least-efficient DMUs vis-à-vis sustainability in these meta-frontiers albeit satisfactory on average.

On the contrary, mean social efficiency in most meta-frontiers is observed to be below 55% except for EAP (57.74%) and MENA (relatively high mean of 63.05%). Lowest social efficiency observed in all meta-frontiers but EAP to be below 10% with the lowest being 2.39% in MENA. These, along with mostly low first quartile and median scores, suggesting generally poor performance of DMUs in dataset vis-à-vis outreach thus a performance boost is imperative. DMUs with very poor outreach also warrant further investigation.

Financial efficiency is also found to have higher correlation to overall efficiency in all but MENA meta-frontier, i.e. above 79% on average. Overall efficiency is thus mainly more influenced by financial efficiency, despite its correlation to social efficiency is generally tailing above 60%, suggesting a general tendency toward financial objective over social objective amongst DMUs observed, confirming Gutiérrez-Nieto et al. (2009).

The highest general tendency toward financial objective is observed in EECA region whose MFIs mainly offer individual loan (65.02% from Table 6.3) followed by combination of individual loan and group loan (26.11%). This phenomenon can also be observed in LAC whose majority MFIs offers individual loan (36.59%) followed by combination of individual and group loan (20.65%). The exception for this tendency toward financial efficiency is MENA wherein correlation of social efficiency to overall efficiency is stronger, i.e. 74.28% vs 55.05%, whilst MFIs herein are mostly offers combination of individual and group loan (63.71%) followed by individual loan (30.65%).

These different conditions thus warrant further analysis to observe the relationship between loan methods and MFI efficiency. These findings also support the argument held that overall efficiency can be used as measure of overall performance but must be completed by its breakdown into financial and social efficiency scores to understand MFI's positioning toward its dual objectives. Certainly, overall efficiency often does not show equal balance between MFI's dual objectives but the efficiency which is the major strength for the assessed MFI.

Table 6.5: Summary DEA Efficiencies I

Regions	DMU	Efficiencies	Mean	Min	TE Score Quartiles			Correlation with Overall TE
					25%	50%	75%	
Africa	180	Overall TE VRS	72.52	10.34	56.52	72.66	93.42	
		Financial TE VRS	67.48	0.24	52.22	67.31	85.39	0.88543
		Social TE VRS	35.75	3.98	12.45	25.85	49.00	0.56532
East Asia & the Pacific (EAP)	161	Overall TE VRS	80.44	37.85	66.18	82.75	100.00	
		Financial TE VRS	73.86	29.13	61.19	72.55	91.44	0.79761
		Social TE VRS	57.74	10.09	37.86	51.64	77.78	0.68261
Eastern Europe & Central Asia (EECA)	203	Overall TE VRS	70.01	20.01	55.09	68.09	86.70	
		Financial TE VRS	63.62	4.76	48.39	61.18	78.00	0.91118
		Social TE VRS	45.02	4.08	28.31	41.20	60.00	0.69710
Latin America & the Caribbean (LAC)	552	Overall TE VRS	70.98	8.78	57.47	70.80	84.34	
		Financial TE VRS	64.85	7.71	54.45	65.51	77.50	0.79153
		Social TE VRS	43.60	6.09	26.79	36.60	55.71	0.61389
Middle East & North Africa (MENA)	124	Overall TE VRS	84.26	39.65	74.45	89.10	100.00	
		Financial TE VRS	85.06	32.35	77.19	91.27	97.53	0.55054
		Social TE VRS	63.05	2.39	40.30	64.69	88.09	0.74281
South Asia (SA)	241	Overall TE VRS	71.44	16.08	59.15	70.73	83.88	
		Financial TE VRS	63.63	7.44	50.06	62.15	77.50	0.83958
		Social TE VRS	51.48	8.13	35.96	48.28	64.07	0.72122

Table 6.6 presents a breakdown of fully-efficient DMUs indicated from the DEA results by loan methods in each regions. Fully-efficient DMUs, i.e. those reaching 100% efficiency thus become benchmarks for similarly-sized DMUs in their respective meta-frontiers, consist of DMUs utilising different loan methods. The first a priori notion herein is that DMUs employing mostly used loan method in a particular region will dominate as benchmark DMUs. Indeed, the consistent results to this are observed in EECA, LAC, Africa and MENA since DMUs with major loan methods dominate as benchmark. Nevertheless, DMUs employing individual loan are also found dominating benchmark DMUs in all efficiency measures in SA and EAP despite consisting of fewer number than DMUs employing group loan and combination of individual and group loan. This is a counter-intuitive finding considering SA as the birthplace of group lending.

Table 6.6: Summary DEA Efficiencies II – Breakdown of Efficient DMUs by Methods

Regions	DMU	Efficiencies	Fully-Efficient DMUs by Loan Method Type*							
			Total	1	2	3	4	5	6	7
Africa	180	Overall TE VRS	36	2	6	-	18	3	-	7
		Financial TE VRS	30	2	3	-	10	2	-	3
		Social TE VRS	14	1	4	-	8	1	-	-
East Asia & the Pacific (EAP)	161	Overall TE VRS	41	19	16	-	6	-	-	-
		Financial TE VRS	25	12	11	-	2	-	-	-
		Social TE VRS	28	11	11	-	6	-	-	-
Eastern Europe & Central Asia (EECA)	203	Overall TE VRS	34	23	2	-	7	-	-	2
		Financial TE VRS	23	18	1	-	2	-	-	2
		Social TE VRS	14	9	2	-	2	-	-	1
Latin America & the Caribbean (LAC)	552	Overall TE VRS	49	20	5	3	2	9	1	9
		Financial TE VRS	28	18	3	-	2	3	-	2
		Social TE VRS	24	5	3	3	-	8	-	5
Middle East & North Africa (MENA)	124	Overall TE VRS	36	11	4	-	21	-	-	-
		Financial TE VRS	15	7	-	-	8	-	-	-
		Social TE VRS	20	6	4	-	10	-	-	-
South Asia (SA)	241	Overall TE VRS	29	11	5	7	3	3	-	-
		Financial TE VRS	17	7	1	3	3	3	-	-
		Social TE VRS	17	7	3	7	-	-	-	-

*1 = individual loan
2 = group loan
3 = village banking loan
4 = combination of individual and group loan
5 = combination of individual and village banking loan
6 = combination of group and village banking loan
7 = combination of all loan methods

Second a priori presumption derived from literatures is that DMUs employing individual loan dominate benchmark for financial efficiency whilst those employing group and village banking loan for social efficiency. In this regard, it is indeed observed that mostly individual loan DMUs that act as benchmark for financial efficiency in EECA, LAC, SA, and EAP meta-frontiers; yet in the latter they almost matched by group lending DMUs as benchmark DMUs for financial efficiency. In MENA and Africa, however, those combining individual and group loan dominate as financial efficiency benchmark. The findings in the latter two meta-frontiers show that generalisation of 'best loan method' may not be appropriate.

Regarding social efficiency, the findings are contrary to expectation that group lending or village banking DMUs do not dominate as benchmark in all meta-frontiers; group lending DMUs instead tie with individual lending DMUs in EAP whilst village banking DMUs tie with individual lending DMUs in SA. Individual lending DMUs on the other hand dominate social efficiency benchmark in EECA whilst DMUs using combinations of loan methods dominate social efficieny in the other meta-frontiers observed. These findings thus reaffirm the invalidation of result generalisation; group and village banking MFIs may not always dominating as the best performing in terms of outreach.

As in the first study, DMUs are then mapped in SFE matrix for each region, with financial efficiency at Y axis and social efficiency at X axis. This SFE matrix is one of the contributions made in this overall research as a useful tool to track MFI performance. The a priori presumptions established herein are DMUs using solely individual loan to have higher financial efficiency whilst DMUs employing solely group or village banking loan to have higher social efficiency. Yet, presumption upon DMUs with loan method combinations cannot be established due to non-existent literatures with empirical evidence in this regard. In the SFE matrix used in this study, the MFIs in each region are grouped over the loan methods or combinations that they offer to the borrowers.

From regional SFE matrices presented in Figure 6.3a, 6.3b, and 6.3c, it can be observed that, barring MENA meta-frontier, most DMUs are mapped at quadrant II of low social – high financial efficiency, including in EAP and SA where the DMUs are actually clustered around the border of quadrant I and II with slightly more in quadrant II. Whilst these suggest a relatively satisfactory performance toward financial sustainability, their positions in quadrant II nevertheless signify a generally weak performance vis-à-vis social efficiency, or mediocre at best just like in EAP and SA wherein DMUs score roughly at the median of social efficiency.

Figure 6.3a: SFE Matrix in African and EAP Meta-frontiers

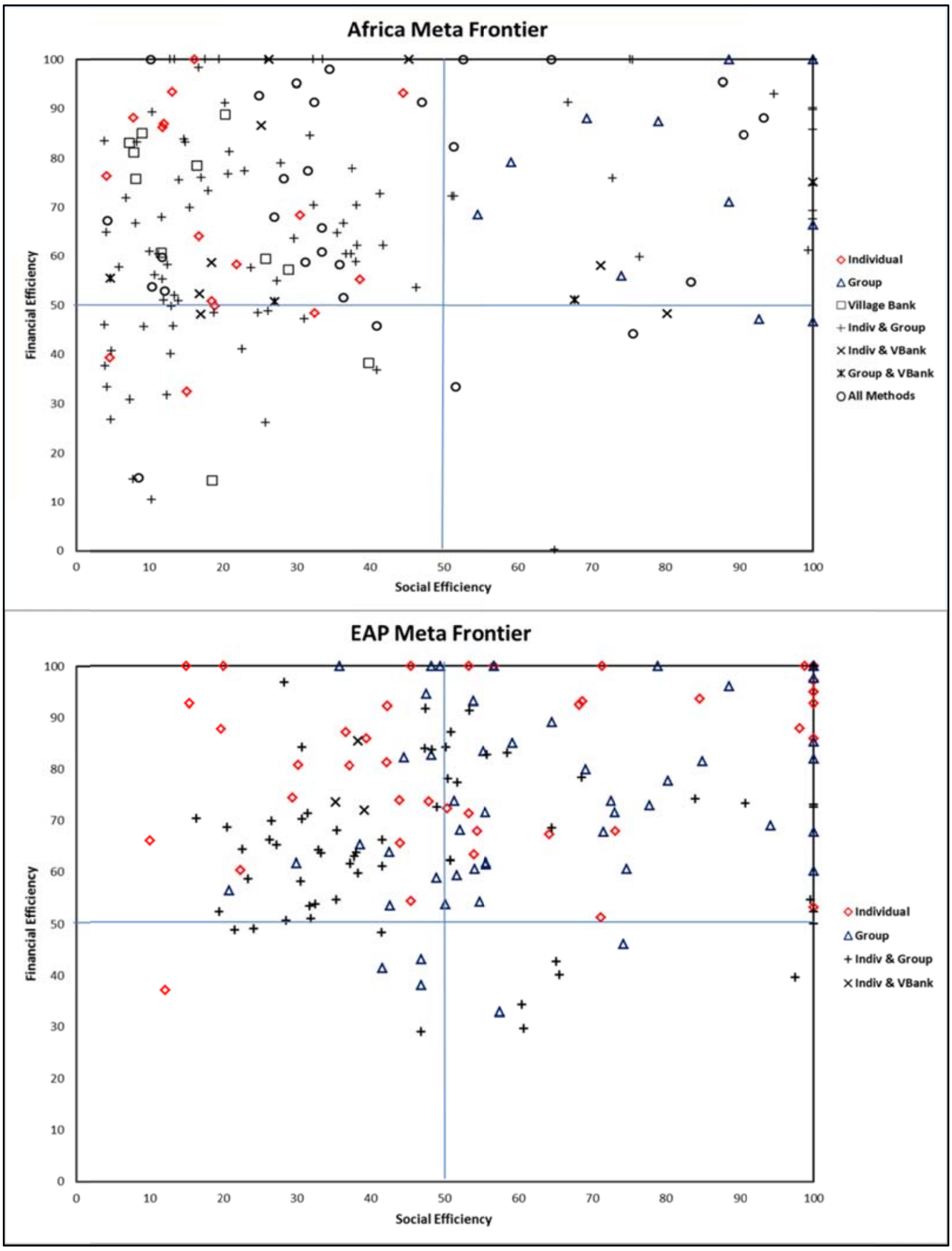
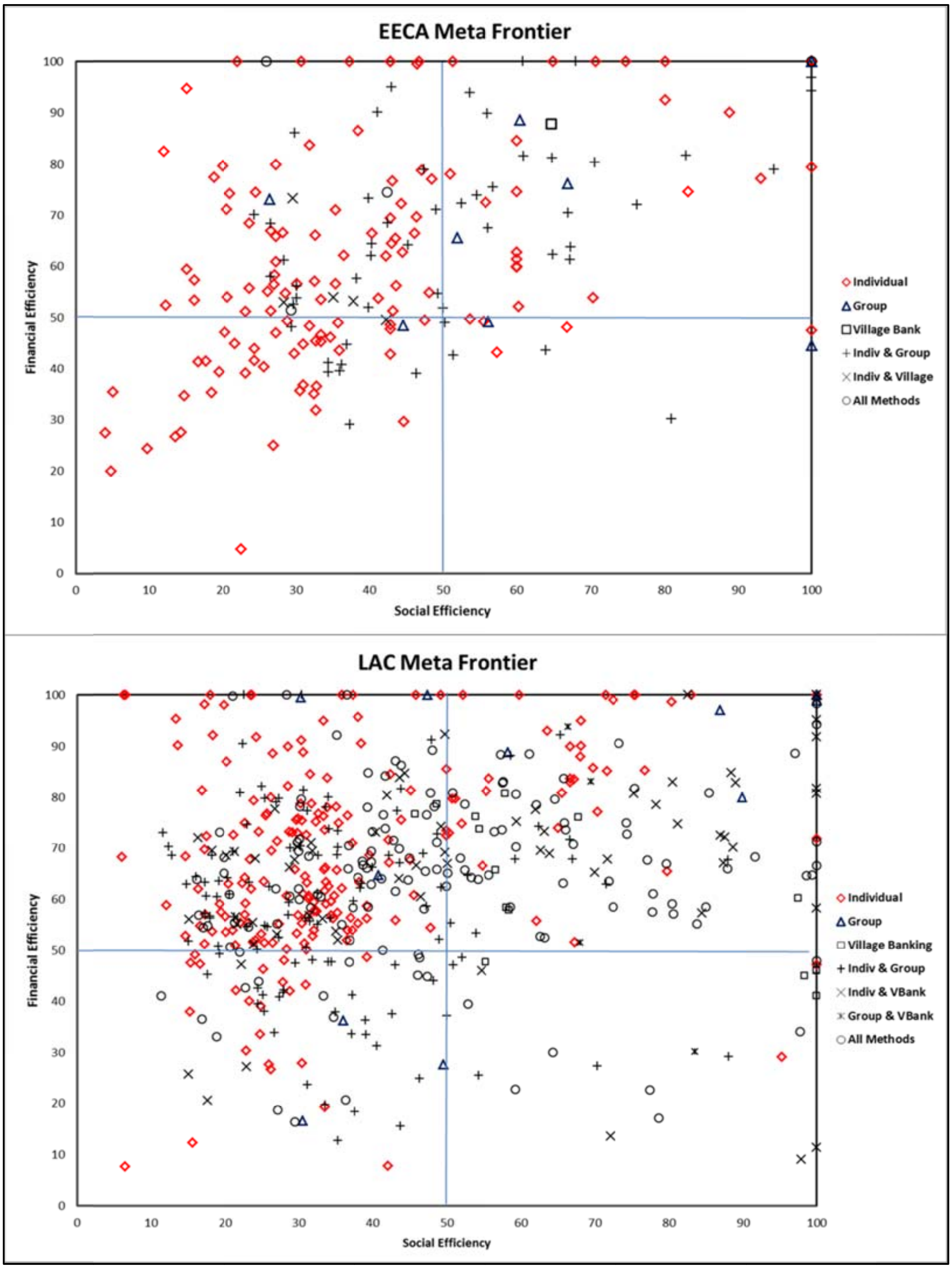
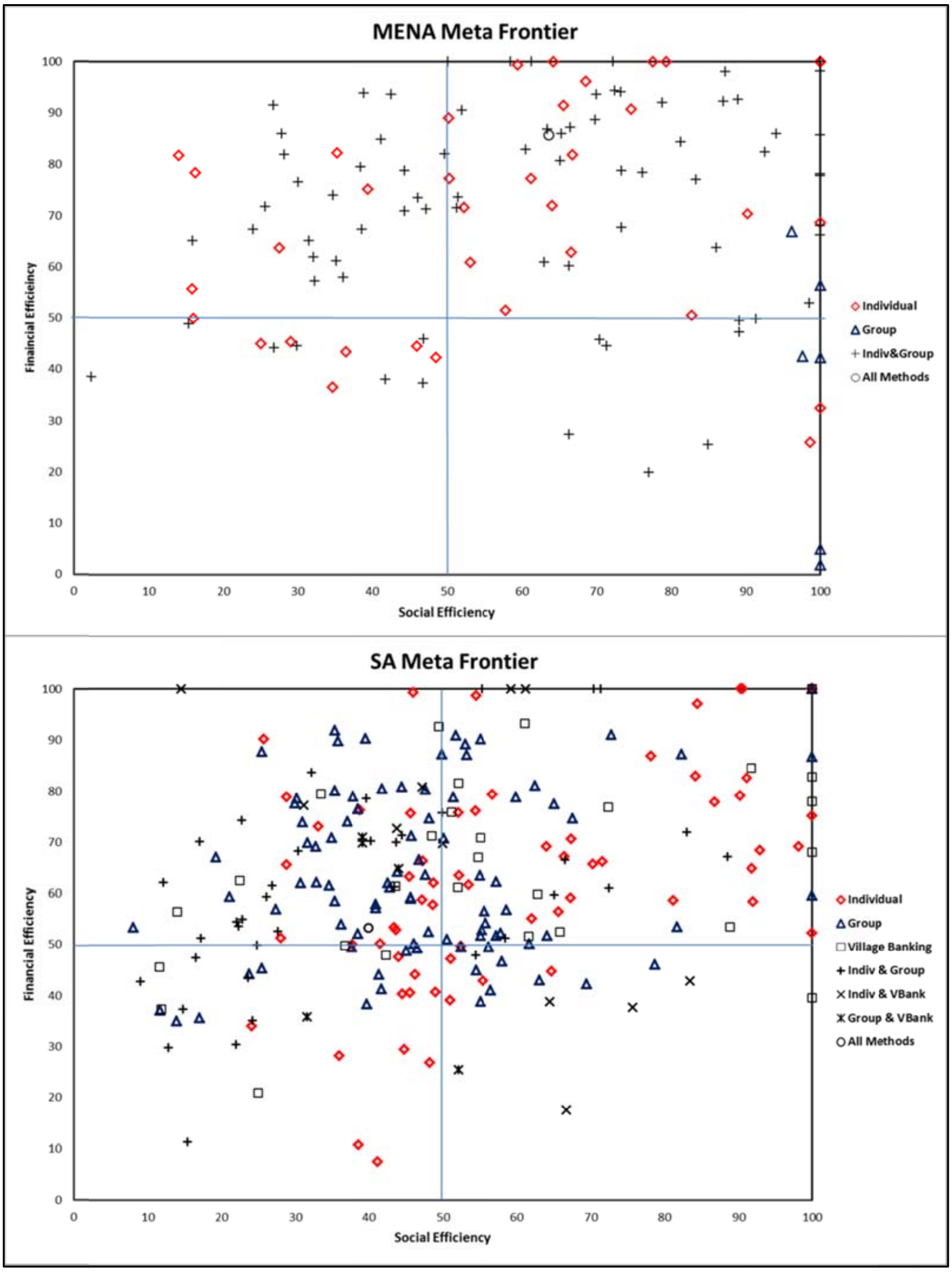


Figure 6.3b: SFE Matrix in EECA and LAC Meta-frontiers



This is quite alarming since social efficiency is fundamentally regarded as *raison d'être* of microfinance, distinguishing it from traditional financial institution – particularly for not-for-profit MFIs under assessment. Many African, EECA, LAC and SA DMUs are also mapped at quadrant III, showing poor outcome on both social and financial efficiency. This is where DEA comes in handy as DMUs with weak performance can emulate efficient benchmark peers assigned thereto. Conversely, most MENA DMUs are mapped in quadrant I; a generally satisfactory performance in both objectives.

Figure 6.3c: SFE Matrix in MENA and SA Meta-frontiers



The next step in the SFE matrix is classifying the DMUs in each matrix into different types of loan methods or combination in their offering. As can be observed in Figure 6.3a, 6.3b, and 6.3c, the findings from the SFE matrices again contradict the a priori presumption: an absolute generalisation across all regions cannot be established regarding loan methods – efficiency relationship. For example, many village banking DMUs in Africa and group lending DMUs in SA are plotted at quadrant II and III of low social efficiency, whilst many individual loan DMUs in African and SA at quadrant III of low financial efficiency. Theoretically, DMUs employing combination of group lending or village banking with individual lending, or those combining all methods, should be located in quadrant I in all regions yet this is not obvious from the findings. From SFE matrix in SA meta-frontier in Figure 6.3c, DMUs employing group loan are leaning more toward quadrant II showing strong performance in financial efficiency but low social efficiency, whilst DMUs offering individual loans are mapped at quadrant 1 of high social and financial efficiency. These results challenge the general understanding from current literatures as well.

Consequently, generalisation cannot be confirmed in regard to one loan method over another as single best method for microfinance offering globally as different loan methods/combinations are observed in quadrant I in different meta-frontiers. These necessitate a post DEA assessment to investigate which loan method(s) that can generally deliver higher efficiency measures in each meta-frontier. These findings also support the initial argument established in this study that every region may have different 'preference' over loan method that can boost MFI performance.

VI.6. Second Stage Analysis: Tobit Regression

At this stage, regression analysis is performed on overall, social, and financial efficiency scores using censored Tobit regression to observe which loan method(s) that generally delivers higher efficiency scores in each meta-frontier, i.e. running 18 Tobit regression analyses in total for three efficiency measurements in each of six meta-frontiers. Possible curvilinear relationship is assessed by including square format for three loan methods, real yield on gross portfolio, borrowings and total donation. The complete Tobit regression model can be reviewed in Section VI.3.1.3. However, the focus will be on the loan methods – efficiency relationship, hence brief summary on findings for other factors are presented herein.

VI.6.1. Loan Method Relationship to Efficiency

The initial presumption with regard to loan method – efficiency scores linear relationship is that from literatures, i.e. individual loan will prevail in financial efficiency whilst group loan and village banking loan excel in social efficiency. As overall efficiency in the findings has high correlation with financial efficiency except in MENA, it would be presumed that individual loan prevail in all but MENA. On the contrary, it is presumed that group and village banking loan to have positive relationship with social efficiency though having negative relationship with financial efficiency hence also with overall efficiency (Obaidullah, 2008a; Westley, 2004). The regression results for loan methods are presented in Table 6.7a and 6.7b, with graphical illustration of these three basic loan methods to efficiency depicted at Figure 6.4, 6.5, and 6.6.

VI.6.1.1. Individual Loan – Efficiency Relationship

The regression results in Table 6.7a and 6.7b show that individual loan method have significant positive linear relationship with not-for-profit MFIs overall efficiency in consistency with initial presumption, except for that in MENA, African, and SA meta-frontiers. Even though the correlation between overall efficiency and financial efficiency in MENA meta-frontier is not as high as in others, a significant positive relationship between individual loan and overall efficiency is observed herein. On the other hand, there is no significant relationship found between individual loan and overall efficiency that can be observed in SA and African meta-frontiers. The result from SA is interesting due to the fact many big MFIs including ASA and Grameen Bank in Bangladesh have started switching toward individual loan to boost its performance – with ASA completely shunned group loan from its current new loan offerings.

It is noteworthy to mention that individual loan is found to have significant curvilinear relationship with overall efficiency in EECA in the form of significant concave relationship. This means that an increase in individual loan offering relates positively with increase in overall efficiency in EECA meta-frontier until it reach a point beyond which the overall efficiency will fall (i.e. the relationship becomes negative). However, as can be seen in Figure 6.4, the maximum point will only be reached after extending a very large size of individual loan. Therefore, it may only affect big MFIs in EECA region.

Table 6.7a: Tobit Regression Coefficients – Loan Methods – Africa, EAP, and EECA

	Africa			EAP			EECA		
	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
Individual	0.0260641	0.0677872	-0.04794	0.2259296	0.188291	0.216551	0.165632	0.126234	0.052824
	[0.352]	[0.013][b]	[0.121]	[0.003][b]	[0.003][b]	[0.017][b]	[0.008][b]	[0.033][b]	[0.349]
Individual squared	0.0000116	-0.0000236	0.000038	-0.0001562	-0.00012	0.000038	-0.00016	-0.00011	-0.00002
	[0.718]	[0.453]	[0.264]	[0.477]	[0.395]	[0.898]	[0.06][b]	[0.165]	[0.809]
Group	0.1396255	0.0705433	0.244823	0.0867047	0.046793	0.136408	0.388205	0.339451	0.154028
	[0.013][b]	[0.158]	[0.000][a]	[0.086][c]	[0.331]	[0.018][b]	[0.01][b]	[0.02][b]	[0.282]
Group squared	-0.0001099	-0.0000454	-0.00024	0.000055	0.000239	-0.000139	-0.0014	-0.00112	-0.00088
	[0.054][c]	[0.382]	[0.000][a]	[0.715]	[0.096][c]	[0.396]	[0.064][c]	[0.13]	[0.235]
Village	0.7765556	0.4895829	1.180382	-1.769759	-1.06909	-1.017674	2.222186	2.349085	-1.61753
	[0.014][b]	[0.11]	[0.001][b]	[0.646]	[0.785]	[0.826]	[0.2]	[0.182]	[0.292]
Village squared	-0.0058604	-0.0039959	-0.00833	0.0359396	0.022402	0.009818	-0.02895	-0.03605	0.027549
	[0.081][c]	[0.22]	[0.028][b]	[0.77]	[0.858]	[0.947]	[0.271]	[0.178]	[0.231]
Dummy variables for loan methods:									
Group Loan	18.18123	4.013998	36.10391	-0.4414859	3.010004	4.106721	3.438791	-1.30637	12.07702
	[0.025][b]	[0.594]	[0.000][a]	[0.922]	[0.5]	[0.44]	[0.735]	[0.895]	[0.227]
Village Banking Loan	-23.34147	-17.80987	-26.5259				3896.536	4993.236	-3821.57
	[0.007][b]	[0.038][b]	[0.008][b]				[0.282]	[0.175]	[0.227]
Individual & Group Loan Combi	2.843853	4.332787	-0.74168	-6.468379	-5.16581	-4.850714	-0.31182	-4.94101	6.29806
	[0.542]	[0.348]	[0.891]	[0.159]	[0.256]	[0.371]	[0.953]	[0.346]	[0.231]
Individual & Village Banking Combi	-14.58848	-15.45832	-14.8032	21.67201	17.838	15.84514	-32.6561	-30.4489	16.77099
	[0.141]	[0.11]	[0.189]	[0.231]	[0.332]	[0.466]	[0.232]	[0.27]	[0.505]
Group & Village Banking Combi	-32.31518	-29.06026	-30.6792						
	[0.013][b]	[0.025][b]	[0.043][b]						
All Loan Method Combi	-8.891292	-3.519451	-15.8096				13.16755	24.99871	7.518227
	[0.179]	[0.588]	[0.038][b]				[0.346]	[0.072][c]	[0.57]

[a] Significant at 99.99% confidence interval

[b] Significant at 95% confidence interval

[c] Significant at 90% confidence interval

It is also observed that individual loan's relationship to financial efficiency is almost identical to its relationship to overall efficiency, except in African and LAC meta-frontiers, as per assumption. In African meta-frontier, individual loan has significant positive relationship with financial efficiency, in line with a priori notion. In LAC meta-frontier, however, individual loan does not have significant relationship with financial efficiency. Consequently, in contrary to presumption, increased offering of individual loan does not necessarily correlates with increase in financial efficiency in LAC, all other factors in the model being at their average. These relationships are illustrated at Figure 6.5.

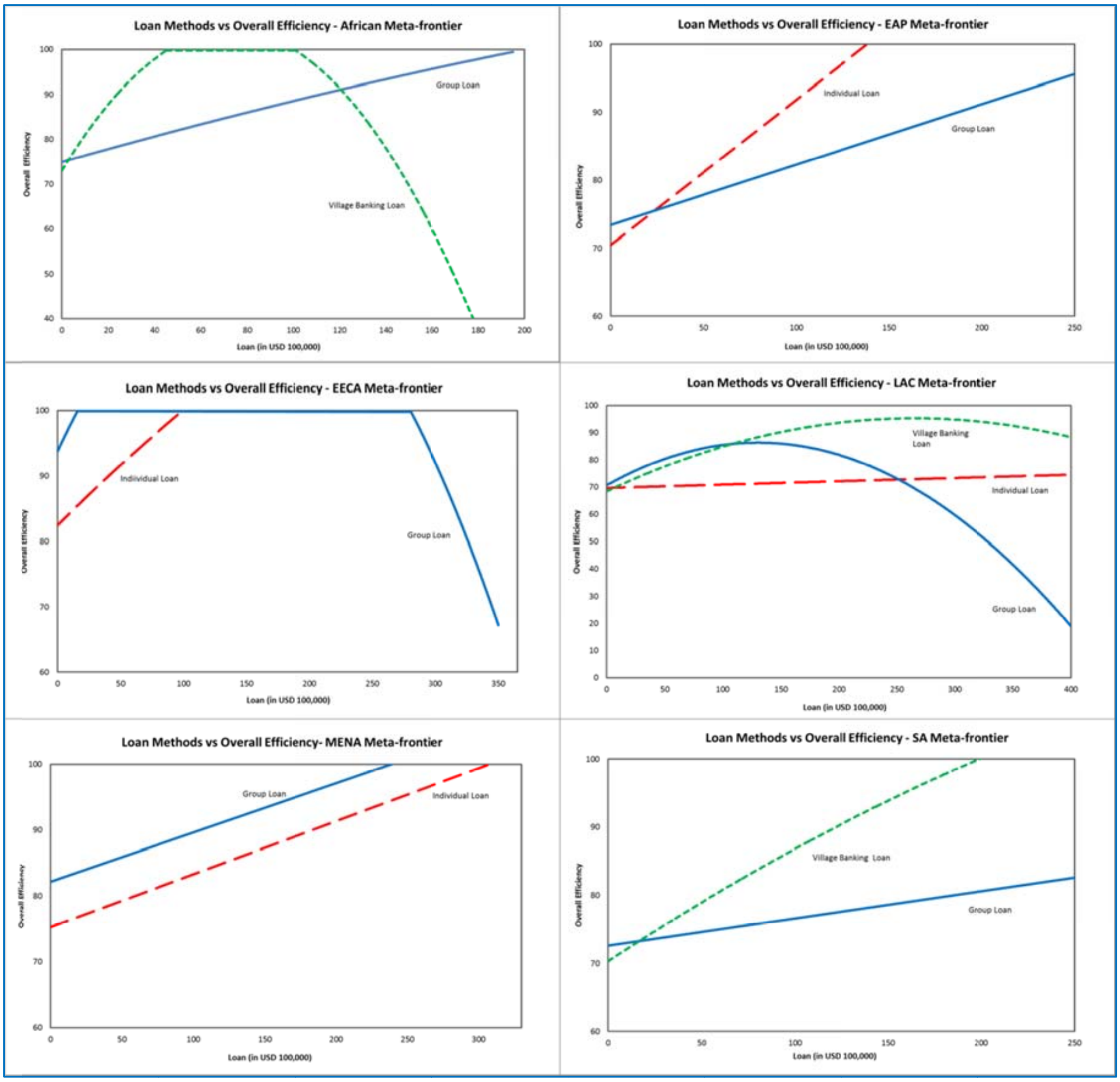
Table 6.7b: Tobit Regression Coefficients – Loan Methods – LAC, MENA, and SA

	LAC			MENA			SA		
	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
Individual	0.0122647 [0.008][b]	0.0079981 [0.109]	0.009261 [0.046][b]	0.078719 [0.007][b]	0.065148 [0.04][b]	-0.012761 [0.755]	0.0228186 [0.185]	0.013823 [0.435]	0.040286 [0.042][b]
Individual squared	-0.0000011 [0.152]	-0.0000007 [0.447]	-0.000001 [0.165]	0.000007 [0.856]	-0.000052 [0.17]	0.000159 [0.011][b]	-0.0000033 [0.293]	-0.000002 [0.614]	-0.000006 [0.084][c]
Group	0.2309385 [0.002][b]	0.1049335 [0.193]	0.265827 [0.001][b]	0.082364 [0.022][b]	0.098466 [0.019][b]	0.08434 [0.081][c]	0.0506859 [0.079][c]	0.037761 [0.203]	0.083095 [0.014][b]
Group squared	-0.000926 [0.002][b]	-0.000503 [0.114]	-0.00099 [0.002][b]	-0.000031 [0.368]	-0.00002 [0.648]	-0.000007 [0.88]	-0.0000286 [0.294]	-0.000035 [0.197]	-0.000042 [0.206]
Village	0.190626 [0.000][a]	0.0634907 [0.151]	0.407591 [0.000][a]				0.1743589 [0.002][b]	0.200972 [0.000][a]	0.140846 [0.021][b]
Village squared	-0.000383 [0.001][b]	-0.000122 [0.326]	-0.00076 [0.000][a]				-0.0001595 [0.012][b]	-0.000196 [0.003][b]	-0.000119 [0.098][c]
<u>Dummy variables for loan methods:</u>									
Group Loan	6.980715 [0.172]	9.817253 [0.068][c]	17.55719 [0.001][b]	23.84905 [0.024][b]	-43.14635 [0.000][a]	45.35036 [0.002][b]	-5.533652 [0.143]	-0.65404 [0.866]	-17.9451 [0.000][a]
Village Banking Loan	8.496272 [0.065][c]	-12.88655 [0.008][b]	23.76816 [0.000][a]				-6.8842 [0.191]	-8.42608 [0.119]	-7.28234 [0.235]
Individual & Group Loan Combi	-12.30319 [0.000][a]	-13.68065 [0.000][a]	-6.04798 [0.007][b]	1.897782 [0.686]	0.5303064 [0.919]	4.702107 [0.469]	-9.834916 [0.03][b]	-3.93544 [0.397]	-21.6142 [0.000][a]
Individual & Village Banking Combi	-4.041484 [0.121]	-7.972095 [0.004][b]	0.156735 [0.955]				-0.1748342 [0.978]	-7.72025 [0.245]	-11.0435 [0.14]
Group & Village Banking Combi	-1.976478 [0.82]	-11.63971 [0.196]	2.611017 [0.772]				-16.29915 [0.048][b]	-13.1766 [0.123]	-23.025 [0.019][b]
All Loan Method Combi	-5.855726 [0.007][b]	-7.3241 [0.002][b]	-2.51834 [0.278]	-31.00332 [0.31]	-27.38276 [0.371]	-3.83288 [0.896]	-20.18322 [0.247]	-10.7535 [0.552]	-22.414 [0.278]

[a] Significant at 99.99% confidence interval
[b] Significant at 95% confidence interval
[c] Significant at 90% confidence interval

Interestingly, individual loan challenges generalisation of assumption by having positive linear correlation with social efficiency in EAP and LAC. It also found to have curvilinear relationship with positive-sloping convex relationship in MENA and concave relationship in SA, though the latter with very small coefficient. The positive-sloping convex relationship in MENA suggests that extending individual loan correlates negatively with social efficiency scores up to certain amount; yet beyond that point the relationship with social efficiency scores change to positive, i.e. correlates positively with increase in social efficiency.

Figure 6.4: Overall Efficiency vs Individual, Group, and Village Banking Loan



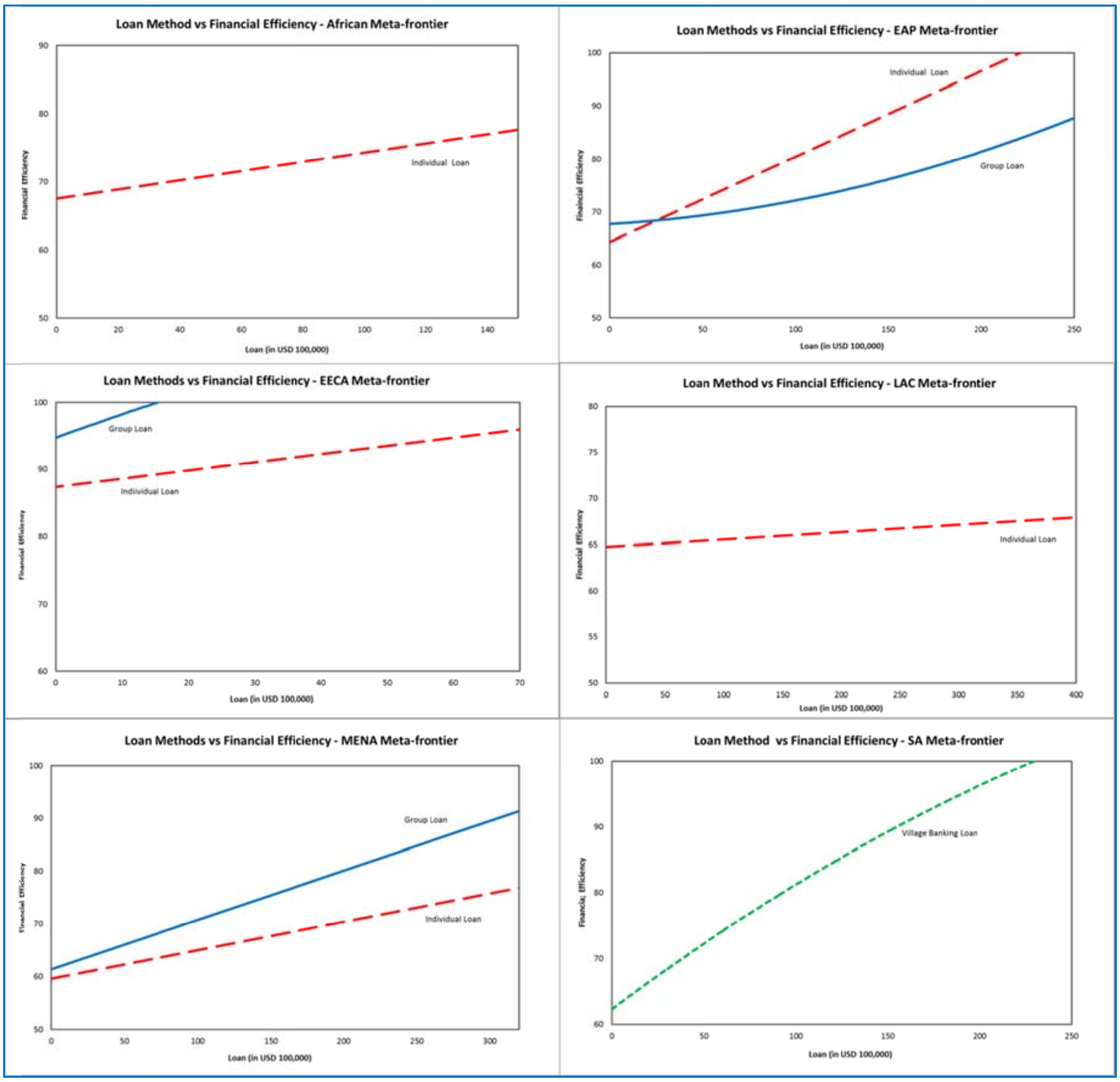
This condition can be explained as follow: if a MENA MFI extends/increases offering of individual loan, it correlates significantly with a decrease in its social efficiency (calculated as the depth of outreach from average loan balance and breadth of outreach from number of borrowers) due to shift in focus from poorest to better-off borrower with higher loan balance, i.e. mission drift in literatures such as Armendariz and Szafarz (2011) and (Gonzalez, 2011), up to a point where individual loan takes over as the major focus for MFI (in terms of number of borrowers taking this loan) then the relationship becomes positive, whereby breadth of outreach, i.e. number of borrowers, becomes the main proxy for outreach thus starts to offset the effect of lower outreach depth (as average loan balance becomes higher) and increases its social efficiency scores. This is because DEA maximises the strength of the DMU assessed. In this dataset, keeping all other variables at their mean, this critical point is USD 19 Million, above which social efficiency score (from breadth of outreach) starts to increase.

Concave relationship in SA on the contrary suggests that extending/increasing individual loan in this region exhibit positive relationship with outreach up to a point; the breadth of outreach offsetting depth until total loan extended reach a certain amount beyond which outreach will decrease. However, due to its very small concavity, its graphical depiction in Figure 6.6 is almost identical to a linear positive relationship. Due to very large amount of individual loan that needed to be extended before the maximum point is reached, this may happen when MFI becomes very big and shift focuses to serving clients with larger loan size rather than serving many clients with smaller loan. Vanroose and D'Espallier (2013) stated about this possibility, i.e. in the area where access to the traditional financial system is not well-developed (such as in SA region), there is a window open for mission drift in a well-established MFI to focus on larger-sized loans.

VI.6.1.2. Group Loan – Efficiency Relationship

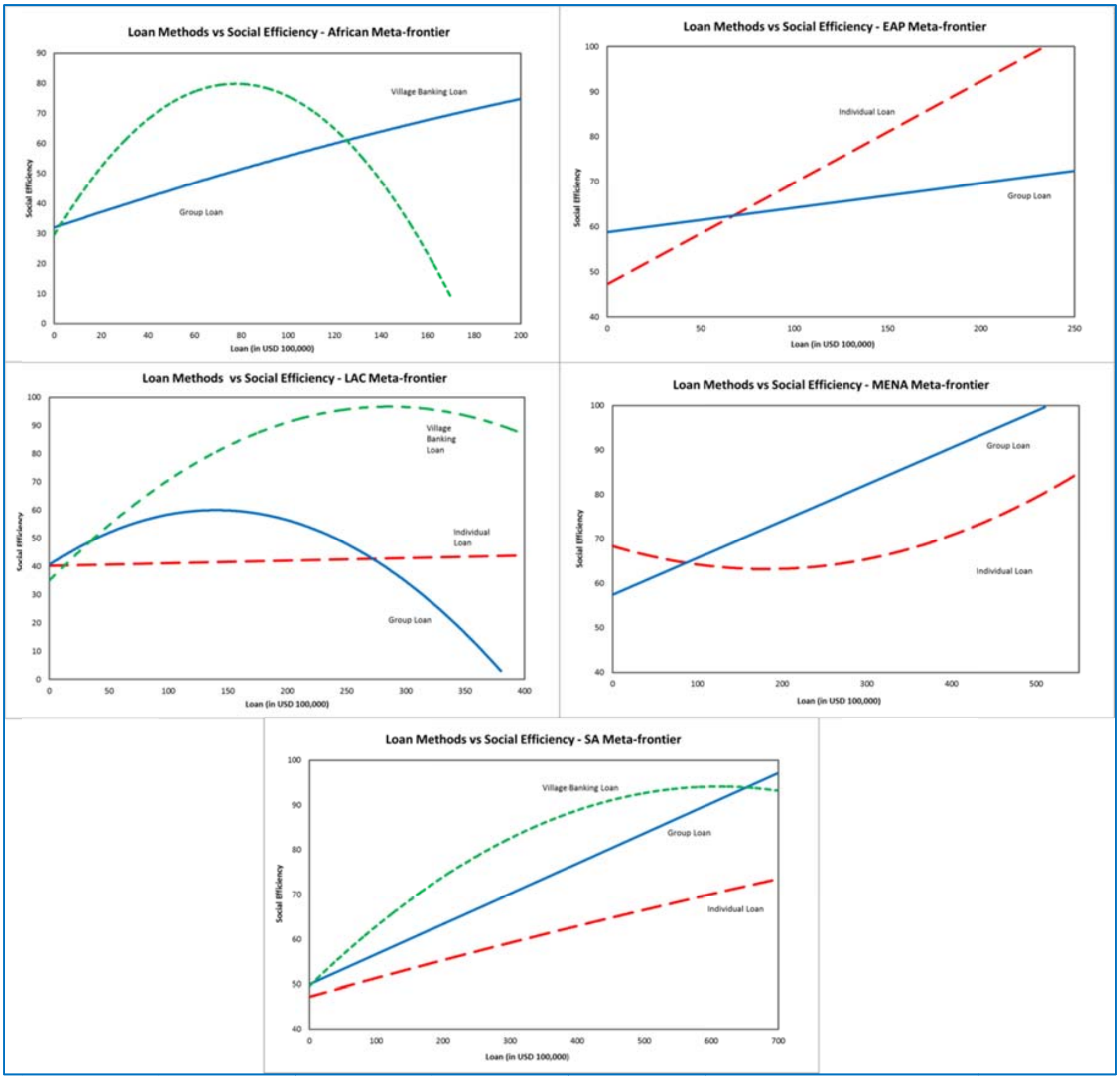
The results of the second stage Tobit regression regarding group loan relationship to efficiency also offers several new insights. In regard to financial efficiency that can be observed in Figure 6.5, findings in three meta-frontiers are in contrary to initial assumption: group loan exhibits significant positive linear relationship in MENA and EECA meta-frontiers and also significant positively-sloped convex relationship in EAP meta-frontier. In EECA meta-frontier group loan even shows a strong relationship with financial efficiency, i.e. if other variables in regression model are constant at their means, additional USD 10,000 of group loan correlates positively with increase in financial efficiency by 3.39%. The rest of the meta-frontiers reveal that there is no significant linear or curvilinear relationship between group loan and financial efficiency. Specifically, there are no significant negative correlations found between group loan and financial efficiency in the rest of the meta-frontiers observed. Therefore, initial assumption of negative relationship cannot be confirmed.

Figure 6.5: Financial Efficiency vs Individual, Group, and Village Banking Loan



In EAP meta-frontier, a convex relationship is observed whereby, if all else constant at their means, offering group loan herein may initially correlates negatively with a decrease in financial efficiency due to transaction costs until group loan reaches USD 7.5 Million, beyond which the correlation becomes positive as financial efficiency begin to rise. This can be attributed to transaction costs associated with group loan offering. The model shows that interest revenue from group loan lent out offset transaction costs only after the loan is extended beyond this amount. This finding proposes extending medium to larger scale group loan in EAP may offset transaction costs which affected smaller scale group loan offerings, thus will correlates positively with financial efficiency.

Figure 6.6: Social Efficiency vs Individual, Group, and Village Banking Loan



Against overall efficiency, group loan also exhibits contrary findings to presumption with positive linear relationship in EAP, MENA, and SA meta-frontiers and concave relationship in EECA, LAC, and African meta-frontiers; the latter with very small concavity. Its concave relationship in EECA and LAC suggests that extending group loan correlates positively with increase in overall efficiency scores until it reaches USD 28 Million and USD 12 Million, respectively; beyond which group loan exhibits negative relationship with overall efficiency. These relationships are illustrated at Figure 6.4. The small concavity in African meta-frontiers makes the group loan curve almost resembles that of linear positive relationship, i.e. the maximum point is only reached after extending group loans in very large amount.

Regarding social efficiency, consistent results with presumption are found in five meta-frontiers, i.e. group loan exhibits significant positive linear relationship in EAP, MENA, and SA meta-frontiers. Our model also observes concave relationships in African and LAC meta-frontiers, indicating that there exists a maximum amount for group loan beyond which it corresponds negatively to social efficiency. As per Figure 6.6, group loan up to USD 14 Million in LAC corresponds positively to social efficiency, yet beyond this amount its relationship to social efficiency turns negative. Very small concavity in African region indicates that group loan offering exhibits positive relationship with social efficiency until approximately USD 68 Million, beyond which this relationship turns negative. Thus, consistency with presumption in these regions is observed albeit up to a point.

Concave relationships in these two regions nonetheless warrant further investigation, especially in LAC region. Since DEA outputs as proxy for social outreach herein are average loan balance per borrower over GNI per capita and number of borrowers, the concave relationship after certain loan amount may correlate to an increase in average loan balance and/or reduction in number of borrowers. These findings may indicate an increase in average loan balance lent to group members as MFI grow due to growing needs from group members for their microbusiness.

VI.6.1.3. Village Banking Loan – Efficiency Relationship

Despite only has significant concave relationship with financial efficiency in SA, the study found no significant negative relationship between village banking and financial efficiency in other meta-frontiers, as stipulated in the initial presumption. Due to its very small concavity, offering village banking loan in SA correlates positively with financial efficiency until USD 83 Million, beyond which the correlation becomes negative. From literatures, this may indicate the higher costs in village banking MFIs due to self-management.

In regard to overall efficiency, the initial assumption cannot also be confirmed since village banking loan exhibits significant concave relationships in African, LAC, and SA meta-frontiers, whilst no significant relationship recorded in EAP and EECA meta-frontiers. The concave relationship in the former three regions means that offering village banking loan correlates positively with overall efficiency, albeit turned negative beyond certain amount. Keeping other variables are constant at means, this model suggests a maximum village banking amount of USD 10.5 Million in Africa, USD 28 million in LAC and USD 94 million in SA before its correlates negatively to overall efficiency.

Village banking loan also has concave relationship to social efficiency in these three regions, consistent to presumption. Maximum amount before social efficiency begins to fall are USD 7.5 Million, USD 31 Million, and USD 62 Million in African, LAC, and MENA frontiers, respectively. One possible explanation to these is that village banking loan beyond these amounts is achieved by MFIs increasing average loan balance per borrower (e.g. by lending out larger loan) hence lower social efficiency.

VI.6.1.4. Summary from Loan Method – Efficiency Relationship

The results in the second stage found that offering/increasing group loan in MENA and EECA meta-frontiers correlate to higher financial efficiency than any other methods. Therefore, keeping all other factors in model constant at their means, MFIs in these two regions do not need 'scaling-up' effort, i.e. shift their focus to better-off customer through 'graduation' to individual loan, as per suggested by Dellien et al. (2005), to strive for financial efficiency.

On the contrary, it is found that offering/increasing individual loan in EAP meta-frontier correlates to higher social efficiency and financial efficiency stronger than that of group loan; the model herein indeed observes that group loan initially correlates to higher financial efficiency and social efficiency than individual loan, but relationship of individual loan to financial efficiency and social efficiency becomes stronger after extending USD 3 Million and USD 7 Million, respectively. This may indicate that individual loan is more suitable to gain more penetration therein hence higher number of borrowers reached.

Since both group loan and village banking loan focus on smaller loans and poorer borrower, it is thus interesting to compare these two methods in terms of social efficiency. The model finds that, all other factors constant at means, village banking loan correlates to higher social efficiency than group loan in African, LAC (the birthplace of group loan), and SA meta-frontiers; albeit concave relationship of village banking in all these regions. Extending village banking correlates positively to higher social efficiency until it reaches approximately USD 7.5 Million, USD 29 Million, and USD 59 Million in African, LAC, and SA, respectively, beyond which the relationship becomes negative. Yet, this means that for smaller MFIs, extending village banking loan may help in outreach.

These findings support the argument that loan method impact is not clear cut to all regions since different regions may have different preference over suitable loan method therein.

VI.6.2. Loan Method Ranking

As presented in Table 6.7a and 6.7b and summarised in Table 6.8, findings from dummy variables for seven loan combinations (with individual loan as based analysis) show that different loan methods top the ranks in different regions, i.e. there is no single method that has ultimate advantage in <u>all</u> regions. The results also cannot confirm the generalised notion that group loan and village banking loan to prevail in social efficiency and individual loan to top the financial efficiency scores in <u>all</u> regions. Indeed, it is found that group lending came out first in overall and social efficiency in African and MENA meta-frontiers and also in financial efficiency in LAC meta-frontiers, but in the latter region, it is village banking loan that tops the overall and social efficiency. Group loan also came out first in different efficiency in different regions but not single-handedly; it is on par with other methods in top position, i.e. insignificant differences with other methods in the same position. For instance, group loan is on par with individual loan,

loan combination 4 (combination of individual and group loan), loan combination 5 (combination of individual and village banking loan), and loan combination 7 (combination of all loan methods) in financial efficiency in African meta-frontier.

Table 6.8: Loan Method Ranking – Six Meta-frontiers

	Africa			EAP			EECA		
Rank	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**
1	Group Loan	Group Loan Individual Loan Loan Combo 4, 5, &7	Group Loan	No significant differences between methods	No significant differences between methods	No significant differences between methods	No significant differences between methods	Loan Combo 7	No significant differences between methods
2	Individual Loan Loan Combo 4,5, & 7	Village Banking Loan	Individual Loan Loan Combo 4 and 5					Group Loan Individual Loan Loan Combo 4 & 5	
3	Village Banking Loan		Loan Combo 7						
4			Village Banking Loan						

	LAC			MENA			SA		
Rank	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**	**Overall Efficiency**	**Financial Efficiency**	**Social Efficiency**
1	Village Banking Loan	Group Loan	Village Banking Loan	Group Loan	Individual Loan Loan Combo 4	Group Loan	Individual Loan Group Loan Village Banking Loan Loan Combo 5	No significant differences between methods	Individual Loan Village Banking Loan Loan Combo 5
2	Individual Loan Group Loan Loan Combo 5 & 6	Individual Loan Loan Combo 6	Group Loan	Individual Loan Loan Combo 4	Group Loan	Individual Loan Loan Combo 4	Loan Combo 4		Group Loan
3	Loan Combi 7	Loan Combo 7	Individual Loan Loan Combo 5, 6, 7				Loan Combo 6		Loan Combo 4
4	Loan Combi 4	Loan Combo 5	Loan Combo 4						Loan Combo 6
5		Village Banking Loan							
6		Loan Combo 3							

*Loan Combo 4 : Combination of Individual and Group Loan
Loan Combo 5 : Combination of Individual and Village Banking Loan
Loan Combo 6 : Combination of Group and Village Banking Loan
Loan Combo 7 : Combination of all loan methods

Conversely, there are no significant differences between loan methods or combinations in regard to overall, financial, and social efficiency in EAP, for overall and social efficiency in EECA, and for financial efficiency in SA meta-frontiers. These show that all methods perform quite comparably in these efficiency measures. Surprisingly, this study shows that MFI delivering all loan methods in their offering (loan combination 7) to have highest financial efficiency in EECA region.

Furthermore, it is observed that individual loan does not top the rank in financial or in any other efficiency measures in any region single-handedly. Indeed, it ranks first in financial efficiency in Africa, MENA, and also in overall and social efficiency in SA meta-frontier, but it ranked first on par with several loan methods/combinations due to insignificant differences between individual loan and these methods.

Thus, these results can only confirm with notion of best overall MFI method in our dataset of not-for-profit MFIs in regional context, not globally. In this context, it can be observed that group lending as best method of microfinance as in Ahmed (2002) or Dusuki (2008) in terms of overall and social efficiency, but only for the context of African and MENA meta-frontiers. Similarly, this study cannot confirm Cull et al. (2007) suggesting individual lending as best method in financial efficiency as group lending prevails in LAC meta-frontier and individual loan is on par with group loan and other combination methods in African, and MENA meta-frontiers. These results concur with Westley (2004) and Hiatt and Woodworth (2006) in the scope of LAC that village banking is relatively best method in terms of overall and social efficiency, yet group loan outperform it in regard to financial efficiency therein.

It is worthy to note that group loan is not listed in the top position for overall, financial and social efficiency in SA meta-frontier. This is a counter-intuitive result considering that group lending method originated from this region, which thereafter spread globally and created the global microfinance explosion. Individual loan, village banking loan, and loan combination 5 and 7 outperform group loan in terms of social efficiency therein. A possible explanation to this is group loan providers may fail to reach the poorest due to exclusion in peer selection as a consequence of dynamic incentives. There has also been a major shift toward individual loan from group loan amongst SA's MFI giants such as ASA and Grameen Bank (Armendariz de Aghion & Morduch, 2005; Giné & Karlan, 2014).

Nevertheless, due to the limitation of the available data from MIX Market as mentioned in Section IV.3.1.3 and as presented in Table 6.3, several dummy variables have only very limited DMUs in their category. Notwithstanding the fact that extra care had been exercised by not including coefficients from loan method dummy variables that have very limited DMUs in the rank construction, there is still wide differences between mostly-used and least-used loan methods in some regions. Unfortunately, this is unavoidable due to the current data limitation in MIX Market. Even though this the dataset used is perceived as best available sample of not-for-profit MFIs in the regions and periods observed, the findings should be observed subject to the said limitation.

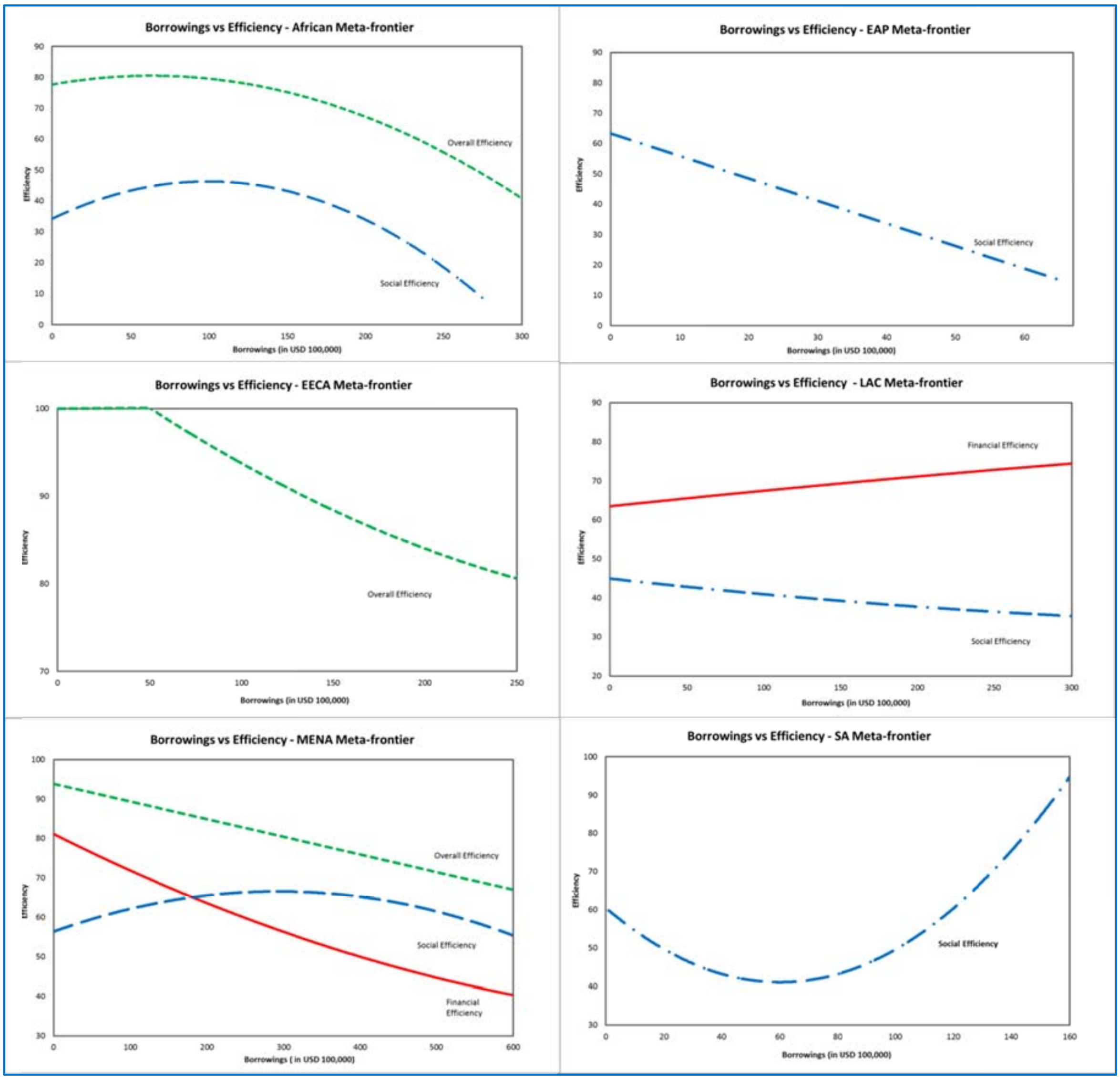
VI.6.3. Borrowings

In Tobit regression results for other efficiency determinants presented in Appendix 15 and the graphical illustration at Figure 6.7, it is found contrary to the presumption that borrowings do not have any significant relationship with financial efficiency in four meta-frontiers in analysis, namely African, EAP, EECA, and SA meta-frontiers. Therefore adding borrowings in these regions will not necessarily correlates to higher interest revenue, i.e. borrowings do not necessarily help MFI in increasing interest revenue due to larger amount of loan extended from it. The initial assumption is that not-for-profit MFIs that are able to access more commercial borrowings will be able to increase its lending capacity hence higher interest income, which is used herewith as the proxy for financial sustainability. This presumption is established as prior anecdotal observation in Indonesia and prior literature review revealed that many not-for-profit MFIs (including IMFIs) sourced their funding from commercial lending due to inability to mobilize deposit. Yet, referring to the results in these four regions, a generalisation regarding the influence of borrowings to financial efficiency cannot be formed.

This argument is supported from the results in LAC and MENA whereby borrowings show concave and convex relationship with financial efficiency, respectively, which can be seen at Figure 6.7. Concave relationship in LAC shows that increased borrowing by MFIs correlates to higher financial efficiency (due to larger amount of loan that can be distributed) but up to certain amount, beyond which it relates negatively with financial efficiency. Literatures indeed show that LAC MFIs have accessed commercial lending extensively as funding sources, e.g. in Gonzalez-vega et al. (1996) and (Gonzalez, 2011), thus increased borrowings may correspond to higher interest revenue. The model indeed finds a maximum amount after which commercial lending relate negatively with financial sustainability, i.e. high dependency toward borrowings may eventually hurt

MFIs financial sustainability. However, the concavity is found to be very small so the relationship depicted graphically in Figure 6.7 almost resembles a linear relationship. This means that initial assumption can only be confirmed in LAC albeit bounded.

Figure 6.7: Borrowings and Efficiency – Six Meta-frontiers



On the other hand, convex relationship in MENA shows that commercial lending exhibits negative relatively with financial efficiency until certain amount where the relationship turns positive. Yet, this convexity is very small that this turning point can only be reached after a very large borrowing. This indicates that increasing commercial lending may have negative effect on interest revenue, which may be explained that due to high interest rate charged by commercial lending, MFIs in turn had to charge higher interest rates to borrowers, which spurred drop-outs or delinquency.

Due to strong correlation between financial efficiency and overall efficiency in all but MENA meta-frontiers, the initial assumption set for overall efficiency is identical to that for financial efficiency. Findings show that the significant relationship of borrowings to overall efficiency is concave in African meta-frontier, convex in EECA, and negative in MENA. These results oppose the assumption in all regions since the concave and convex relationship in Africa and EECA, respectively, are mostly negatively-sloped as well.

Regarding social efficiency, the initial assumption is that commercial borrowings may correlate negatively with outreach due to higher interest rates that eventually charged to clients. The results match this assumption in EAP and, to some extent, in African, MENA, and LAC meta-frontiers. In Africa and MENA, the relationships are actually concave but to some extent correspond to presumption, i.e. borrowing amount of more than approximately USD 10 Million and USD 32.5 Million relates negatively to social efficiency in African and MENA meta-frontiers, after having positive relationship beforehand (which may due to more borrowers that can be reached from additional funding). In LAC the relationship is actually convex but due to very small convexity, it is mostly negatively-sloped until large amount of borrowings. Uniquely, SA result shows that borrowing until approximately USD 6 Million relates negatively to social efficiency (which may happen to smaller MFIs), yet beyond that the relationship turns positive. This may point to the breadth of outreach, i.e. the use of borrowings to reach more borrowers as large MFIs in SA have tapped into traditional banking and capital market for funding, as is the case with SHARE in India (Meehan, 2004) and Grameen Bank in Bangladesh (Schicks, 2007).

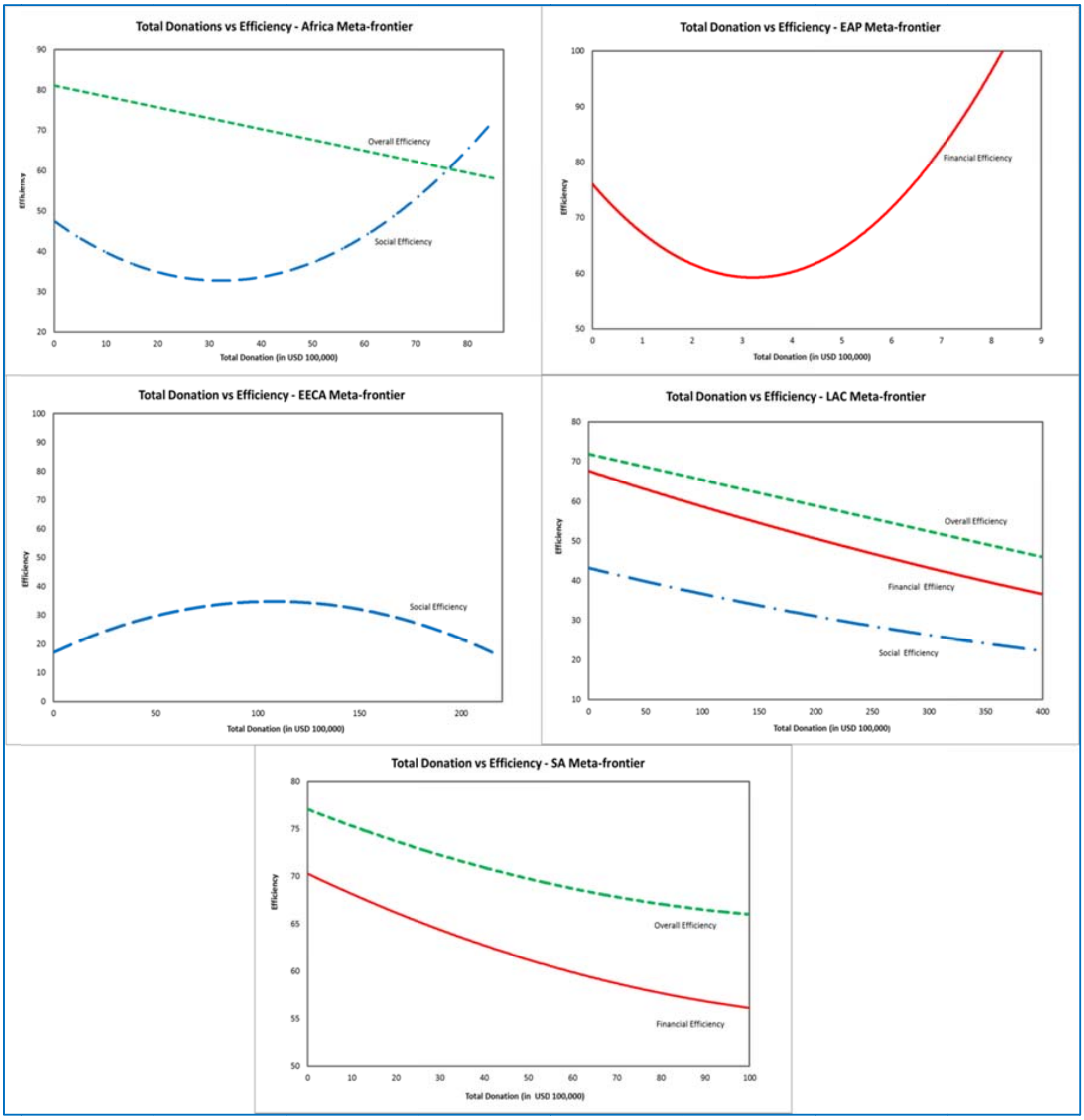
VI.6.4. Total Donations

The initial assumption for total donation is that total donation has positive relationship with overall, financial, and social efficiency as literatures shown that many not-for-profit MFIs have high dependency upon subsidy, and one of the forms of subsidy to MFIs is donation. From the results, it is observed that total donation exhibits significant negative relationship with financial efficiency in LAC and SA regions whilst showing significant convex relationship in EAP. Thus, results from LAC and SA regions defy the assumption, whilst in EAP it concurs with the assumption only after total donation exceeds USD 320,000 mark. The model finds that total donation below this amount in EAP to have negative relationship with financial efficiency.

Regarding its relationship to social efficiency, the result consistent with assumption is only found in Africa to some extent as the relationship is also convex. The result herein matches with assumption only after total donation exceeds USD 35 Million, below which total donation relates negatively with social efficiency. This means that smaller MFIs herein with small total donation received may not be able to rely on donation to lend out small loans and expand their borrowers. On the contrary, the result in LAC also shows a significant convex relationship yet with very small convexity so that the curve is mostly negatively sloped until total donation reached USD 77.5 Million before it has positive relationship with social efficiency. In EECA the relationship is observed to be concave, with total donation relates positively with social efficiency until it reaches USD 11 Million; thereafter, total donation exhibits negative relationship with social efficiency.

Significant relationships with overall efficiency are mostly observed to be negatively-sloped, i.e. in African, LAC and SA regions. In summary, if subsidy is defined narrowly as cash donation and equity donation, the results from this study cannot support Hudon & Traca (2011). Since donation may not necessarily relate to higher efficiency, MFIs may have to think of other funding strategy than relying on donation. These results are graphically presented in Figure 6.8.

Figure 6.8: Total Donations and Efficiency – Six Meta-frontiers



VI.6.5. Cost Per Borrower (CPB)

The presumption set for CPB is that it will have negative relationship with both social and financial efficiency, as per existing literatures. Indeed, it is found that CPB exert significant negative relationship with all measures of efficiencies in Africa and EECA, negative relationship with outreach and social efficiency in EAP and SA, and negative relationship with social efficiency in LAC. There is no positive relationship found in the results for CPB. Therefore, excluding the insignificant relationship in MENA for all efficiencies, this study can generally confirm Lafourcade et al. (2005) in almost all meta-frontiers, i.e. low cost per borrower correlates positively with these efficiencies.

VI.6.6. Portfolio At Risk 30 days (PAR 30) and Portfolio At Risk 90 days (PAR 90)

In MIX database, portfolio at risk presents the percentage of total loan outstanding at risk of default due to having one or more instalments in arrear more than 30 days (for PAR 30) or more than 90 days (for PAR 90). These variables represents risk in operation; a warning sign of future delinquency problem (Rosenberg, 2009). Therefore, these were included in the Tobit regression model to observe its relation to efficiency, i.e. whether DMUs with higher efficiency scores are associated with lower risk or higher risk.

Based on literature reviews, the initial presumption established for PAR 30 and PAR 90 is that they exhibit negative relationship to all efficiency measures. On the other hand, anecdotal interviews and discussions with MFI operatives revealed that PAR 30 is not a major concern for MFIs as much as PAR 90, due to the nature of MFI business in lending to the poorest or informal microbusinesses that are naturally volatile.

Indeed, the results in LAC and Africa showed that PAR 30 is positively correlated to social and financial efficiency whilst PAR 90 contrarily exhibits negative relationship; suggesting that loans in arrears for more than 90 days may be detrimental in efforts to boost performance, yet PAR 30 may be inevitable in this effort. In EAP, however, PAR 90 has positive relationship with social efficiency, indicating that effort to boost outreach in this region may inevitably raise the risk in terms of PAR 90.

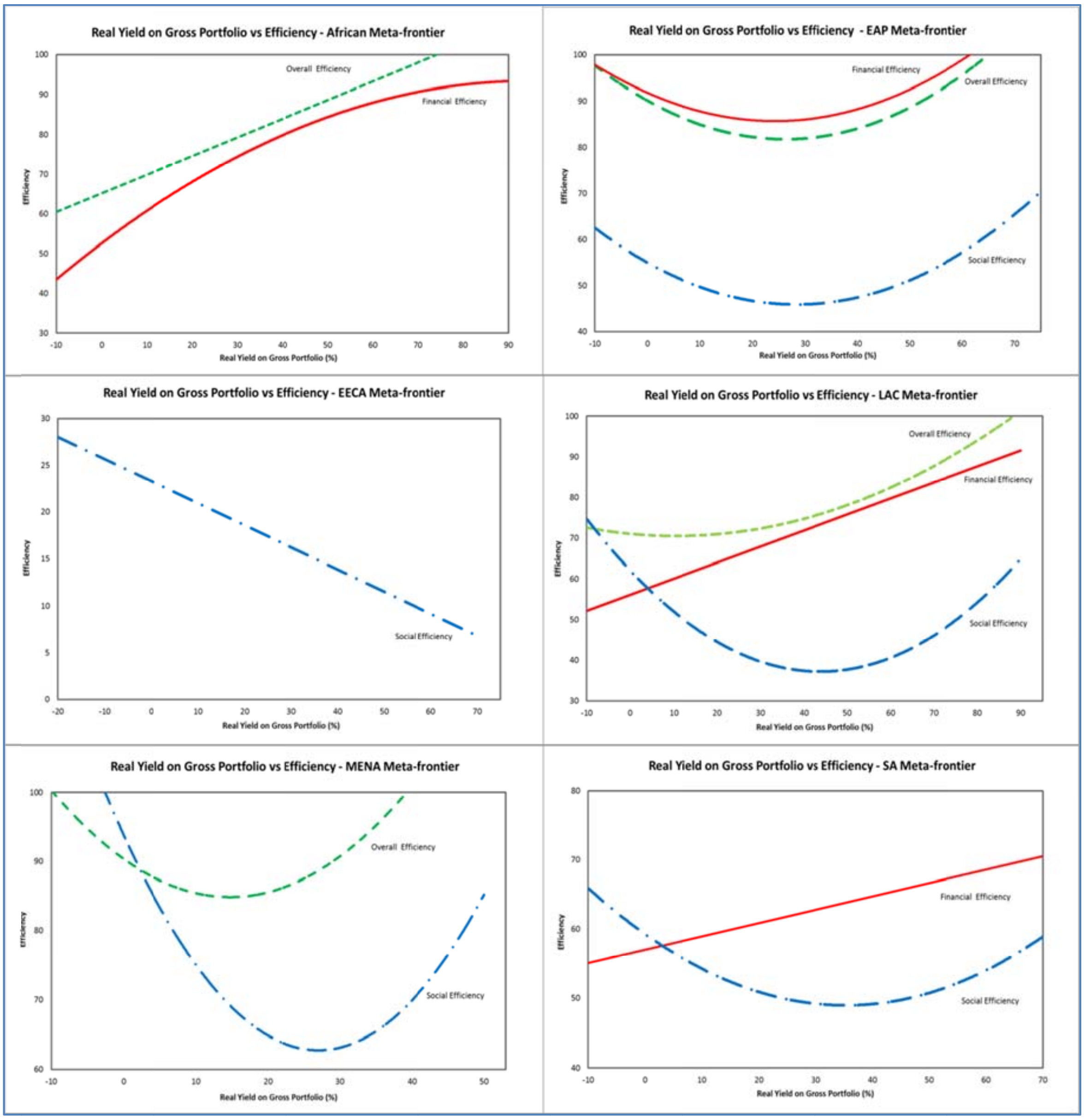
VI.6.7. Real Yield on Gross Portfolio

This variable represents real interest rate charged by MFIs to its borrowers, taking into account the inflation rate in the particular region an MFI is operating. Study by Cull et al. (2007) stated a curvilinear relationship of this variable to MFI performance. Therefore, this variable is included in Tobit regression in its original form and in squared term to observe curvilinear relationship to efficiency measures that may exist. Based on literatures, the initial presumption is that this variable has concave relationship with overall and financial efficiency, and convex relationship with social efficiency. The presumption on financial efficiency is based on the agency theory as per Cull et al. (2007): as interest rates charged is increasing, MFIs will receive higher interest revenue (proxy for sustainability) but up to a point beyond which the loan becomes too expensive and triggers moral hazard – the loan borrowed by low-quality borrowers without intention to repay it. The higher interest rates simultaneously deter more borrowers, especially the poorest, for taking up the loan thereby causing the outreach to fall. On the other hand, the presumption on social efficiency is based on the abovementioned paper plus many other literatures: that group loan and village banking indeed exhibit relatively high interest rates due to their transactional costs, yet on the other hand their outreach is known to be high. Therefore, this model seeks to find empirical evidence to these notions. The graph of the results can be seen at Figure 6.9.

From Tobit regression results in Appendix 15, it can be observed that in regard to social efficiency, real yield has fully convex relationship in EAP, LAC, MENA, and SA regions. These U-shape curves from the model indicate that until certain rates charged, the real interest rates relate negatively to social efficiency, yet beyond these points, real interest rates to have positive relationship with social efficiency. One explanation to this may be that interest rates below these points are associated with MFIs extending individual loan or loan combination involving individual loan (since real interest rates recorded in the dataset are means of all methods utilised in an MFI), thereby increasing interest rates relates to decreasing number of borrowers (one proxy for outreach).

On the other hand, real interest rates above these inflection points, i.e. 28%, 45%, 28%, and 37.5% for EAP, LAC, MENA, and SA respectively, are associated with MFIs utilising group loan, village banking loan, or combination involving these methods. The association of these methods with higher interest rates is due to higher transaction costs, yet with lower average loan balance per borrower so their loans reach poorer borrowers. An extreme example of this can be seen in the case of Compartamos, a successful MFI in Mexico, which charge high interest rates of around 100% yet in the form of small loans (Hamada, 2010). The linear negative relationship observed in EECA also confirms this argument; from Table 6.3 it can be seen that 65.02% MFIs in EECA extends solely individual loan and 26.11% extend both individual and group loan.

Figure 6.9: Real Yield on Gross Portfolio and Efficiency – Six Meta-frontiers



In terms of financial efficiency, real interest rate is found to have significant positive linear relationship in African, LAC, and SA meta-frontiers whilst showing a significant convex relationship in EAP. The results from the first three meta-frontiers confirm the initial presumption that higher real interest rates correlates with higher financial efficiency. Moreover, the convex relationship in EAP also confirms this notion at interest rates higher than 25%. It can be seen at Table 6.3 that in EAP the 32.92% of DMUs under assessment engage solely in group loan whilst 37.27% offers both group and individual loan, i.e. both formed majority in DMU assessed. Therefore the result herein can be explained that interest rates above 25% may represent MFIs extending group loan or combination method involving group loan, which are known to have high interest rates.

VI.6.8. Ranking of MFI Legal Format

The inclusion of four dummy variables of MFI legal format in the Tobit regression from five types in dataset, namely NGO, bank, Credit Union / Cooperative (CU / Coop), Non-Bank Financial Institution (NBFI), and Others (i.e. other MFI formats), is to observe which MFI format that could provide a relatively higher efficiency in each region. NGO is used as base analysis in the model, i.e. all other types are assessed relative to NGO. Included in "Others" herein are MFI formats such as government poverty alleviation programs, foundations, and also rural banks since only a handful of the latter are in the dataset. The initial presumption is that, due to its not-for-profit orientation, NGO will prevail in social efficiency (Dichter, 1996; Haq et al., 2010), but banks will top the financial efficiency rank. The Tobit regression results can be observed in Appendix 15 whilst the summary ranking from the said result is presented in Table 6.9.

Based on the result from Tobit regression, the ranking of MFI legal format that provide higher efficiency scores are different on one meta-frontier to another. NGO tops the rank in social efficiency measures in Africa and SA, yet not single-handedly; it is on par with other formats in this position. NBFI tops social efficiency in EAP, EECA, and SA, whilst Bank outperforms all formats in LAC. NGO finishes last in EECA, along with CU/Coop vis-à-vis social efficiency.

In regard to financial efficiency, Credit Union/Cooperative takes the first position in SA. There are no significant differences between formats regarding financial efficiency in EECA, LAC, and MENA. On overall efficiency, NGO, Bank, and NBFI are on par in first position in LAC. NBFI outperforms all formats in EAP and EECA, whilst NGO and NBFI are in the first rank in Africa.

These results show that generalisation cannot be established as to which legal format that can generally provide the best efficiency in all region. It is empirically shown here that different MFI format prevails in different meta-frontier. Summarily, this study cannot confirm literatures favouring NGO as listed above or favouring any other format as the best provider of microfinance in global scope.

Table 6.9: MFI Legal Format Ranking – 6 Meta-frontiers

	Africa			EAP			EECA		
Rank	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
1	NGO NBFI	NGO NBFI	NGO	NBFI	Other	NBFI	NBFI	No significant differences	NBFI
2	CU / Coop	CU / Coop	CU / Coop	Other	NGO CU / Coop NBFI	Other	NGO CU / Coop		CU / Coop
3			NBFI	NGO CU / Coop		CU / Coop			NGO
4						NGO			

	LAC			MENA			SA		
Rank	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
1	NGO Bank NBFI	No significant differences	Bank	No significant differences	No significant differences	No significant differences	No significant differences	CU / Coop	NGO NBFI Other
2	CU / Coop		NGO					NGO NBFI Other	CU / Coop
3			NBFI						
4			CU / Coop						

As in Section VI.6.2, a proviso needs to be established herein due to the limitation of the available data from MIX Market. Dummy variable for "Bank" in Africa and that for "Other" in MENA, have one and two DMUs in their category, respectively, thus not considered in the rank construction. There are still wide differences between MFI legal formats in some regions, which can be seen in Table 6.3. Unfortunately, this is unavoidable due to the current data limitation in MIX Market. Therefore, the findings should be observed contingent to this limitation.

VI.6.9. MFI Age and Regulatory Status

From the results in Appendix 15, MFI age affects social efficiency in Africa, EAP, and LAC meta-frontiers, where young MFIs are found to have significantly higher social efficiency than matured MFIs as per expectation. On the other hand, mature MFIs have positive relationship with financial efficiency at EECA and LAC meta-frontiers, which also in line with expectation. Interestingly, in MENA younger MFIs is observed to have higher financial efficiency. MFI age does not make significance differences to overall efficiency in all regions. This study confirms Nghiem et al. (2006) that younger MFIs have higher efficiency in EAP region, though limited to social efficiency. On the other hand, it cannot confirm Gutiérrez-Nieto et al. (2009) that stated MFI age does not have significant effect on social efficiency in global frontier.

In regard to MFI regulatory status, regulated MFI is observed to have higher financial and overall efficiency only in LAC meta-frontier. On the other hand, unregulated MFI exhibits significant higher financial efficiency in African and SA regions, higher social efficiency in EECA and MENA, and higher overall efficiency at MENA region. Therefore, this study differs with Lafourcade et al. (2005) who suggested that regulated MFIs have higher social efficiency in the context of African frontier. This study indeed found results that support Fernando (2004) that regulated MFIs have better performance, yet this support is restricted to LAC frontier and not in social outreach; thus similar herein to what Mersland and Strøm (2008) observe regarding outreach. Generally, the results concurs with Hartarska and Nadolnyak (2007), who argued that transformation of MFIs into regulated MFIs does not always lead to better performance in sustainability and outreach, and in all but LAC frontier with Mersland and Strøm (2009) who found that regulated MFIs do not perform better in financial sustainability.

Thus, the results herein do not support generalization that unregulated or regulated MFIs to deliver better performance in microfinance in all regions; rather, the results are different in each regions.

VI.7. Discussion and Conclusion

VI.7.1. Discussion

1. As per initial expectation, this study cannot confirm generalisation that group loan and village banking loan will outperform individual loan in social efficiency and vice versa in financial efficiency as results show different performance amongst regions.

2. Indeed, group loan often comes on top in terms of performance toward efficiencies in some regions (e.g. in all efficiencies in Africa and in some efficiency measures in other regions), but it often placed at the top along with other methods. Thus, it cannot support argument of group loan as the ultimate best method for microfinance.

3. Village banking loan, on the other hand, manage to top overall and social efficiency in its birthplace region of LAC yet it still lacking behind in financial efficiency, as per Westley (2004).

4. Commercial borrowing is observed to not necessarily exhibit positive relationship to efficiency in most meta-frontiers. Commercial borrowing helps MFIs as additional funding source to extend more microloans, yet the burden from the interests payable to commercial borrowing inevitably increases interest rates, thereby negatively correlates to social efficiency in regions where most MFIs offers individual loan exclusively or in combination with other loan methods, i.e. in African, EAP, LAC, and MENA regions. Contrarily, commercial borrowing eventually correlates to higher social efficiency in SA since MFIs extending group loan and village banking loan (which associated with higher interest rates but smaller average loan), either exclusively or in combination with other methods, are accounted for majority of MFIs therein. Commercial borrowing is correlated to larger loan offerings as many big MFIs are tapping into traditional banking as funding sources (Meehan, 2004; Schicks, 2007). Commercial borrowing on the other hand is generally not associated with higher financial sustainability except for a rather flat concave relationship in LAC (i.e. very small concavity). These results propose MFIs to consider their commercial borrowing exposures as findings in most frontiers shows that commercial borrowing

negatively correlates to the overall efficiency and social efficiency yet does not necessarily having positive relationship with financial efficiency as assumed.

5. Subsidy in the form of total donations is also generally not observed to correlate positively with efficiency except with social efficiency in African and with financial efficiency in EAP, where both show convex relationship. Yet, convex relationship with social efficiency in African regioncan be observed after total donations reach USD 33 Million and beyond. Thus, MFIs are suggested to consider their dependency toward total donations as empirical results do not find this to necessarily correlate positively with higher efficiency.

6. In regions with many MFIs offering group loan, village banking loan, and/or their combinations with others, high interest rates are observed to be associated with higher social efficiency but in convex relationship, meaning that real interest rates may positively relates to higher social efficiency after it passes beyond certain rates. This may be attributed to correlation between real interest rates and group loan, village banking loan, and/or combination of these loans with others, whereby these loan methods are associated with low average loan balance but imposing higher real interest rates due to higher transaction costs associated.

7. MFI transformation into regulated MFIs does not always warrant higher efficiency.

VI.7.2. Conclusions

1. Based on the findings of this study, it can be concluded that the concept of "best loan method" for not-for-profit MFIs cannot be generalised for all frontiers. Instead, empirical evidence shows that different loan methods work best in different frontiers, which may be due to different demographics and geopolitics. Moreover, the findings demonstrate that several loan methods as well as combinations of loan methods can produce generally equivalent performance in one frontier.

2. Three basic loan methods of individual loan, group loan, and village banking loan exhibit different relationship to efficiency in different meta-frontier. The linear relationship and curvilinear relationships observed in the study for some efficiency

measures, both convex and concave, indicate that these method – efficiency relationships are not as straightforward as may intuitively suggested from literatures. From these findings, the optimum loan amounts that provide higher efficiency for these three basic methods can be empirically predicted for each region. This finding serves as guidance for MFIs in designing their loan portfolios to achieve higher performance.

3. Not-for-profit DMUs in all regions in this study show generally satisfactory financial efficiency scores. However, in terms of social efficiency many DMUs in all regions but MENA are found to perform less satisfactorily; achieving average scores of less than 50%. Since the output in social efficiency measure resembles depth and breadth of outreach, this finding serves as wake-up call for MFIs and regulators in working on a joint effort to enhance MFIs performance in terms of outreach to the poor, both from MFI management side or from regulatory side.

4. From results presented in Appendix 15 and described in Section VI.6.3 – VI.6.8, the findings on other factors related to efficiencies, i.e. borrowings, total donation, PAR 30, PAR 90, interest rates, MFI age, regulation status, and legal format, support the argument that appropriate performance analysis should best be done on regional basis separately as different results may be observed for different region.

5. The DEA model used in this study is proficient to portray the characteristics in six meta-frontiers as described in literatures in its results, e.g. regarding village banking loan in LAC, individual loan in EECA and EAP, and the gradual shift to individual loan in SA. This supports the argument to propose hyperbolic non-oriented DEA model as alternative method for MFI efficiency assessment.

6. This study thus recommends future research to explore efficiency determinants to be performed in regional basis globally as it may provide more useful insights. Qualitative field study is also recommended to complement / to support quantitative analysis as it furthers the understanding of analysis results.

7. This study recommends MIX and policymakers in all countries to encourage and to incentivise MFIs to submit their performance data so that thorough performance tracking can be established regularly to keep the growth stay in the correct course.

Chapter VII: Productivity of Not-For-Profit MFIs in Times of Crisis

VII.1. Study Background

This chapter explores the final study in this three-part research which focuses on the productivity of not-for-profit microfinance. More specifically, this final study seeks to evaluate productivity of not-for-profit microfinance institutions in the time of external shocks, such as the 2008 global financial crisis. With its dual bottom objectives, microfinance institutions act as an agent of development whilst also operating and having characteristics as financial institutions. As volatility and fluctuations are often inevitable parts in business cycle, and considering MFIs' important role in poverty eradication globally, it is imperative to scrutinise MFIs' performance in times of external shocks in order to build strong resilience in the future.

Prior to 2008 global financial crisis, microfinance is suggested as to have immunity from mainstream macroeconomic volatility and shocks due to its niche business model. It indeed earned high credit for its resilience in the face of 1997 Asian financial crisis and 1999-2000 Latin American crisis whereby MFIs were found to be to some extent immune from these shocks due to its focus on serving the poor. Patten et al. (2001) observed that BRI in Indonesia, the biggest MFIs in the world, outperformed other commercial banks in Indonesia from steady loan repayment rates derived from its microfinance arm, BRI Unit Desa. Krauss and Walter (2009) and Ahlin et al. (2011) also found that MFIs were highly resilient against inflation and GDP contractions.

Moreover, cross-country findings for the period of 1998-2006 offered by Krauss and Walter (2009) demonstrated that there were no significant relationship between the trend of global financial market proxies for global market risk, i.e. in this case S&P 500, MSCI Global and MSCI Emerging Market indices, and MFI credit growth. This weak relationship had suggested evidence of the microfinance imperviousness from financial world volatility. This immunity has been credited to MFI deliberate targeting of poor borrowers, coupled with conservative credit technologies and MFIs' low level integration into domestic and international financial system (Wagner & Winkler, 2013). These in turn translated the growth of MFI outreach as a catching-up effect in economic welfare; and one that is emboldened the financial inclusion in a stable manner.

Impressive growth in microfinance sector five year period prior to global crisis, i.e. in 2004-2008 period (Chen et al., 2010), and its crisis-resilient reputation had attracted many 'traditional' financial investors toward investing into this sector (Huijsman, 2011). Pension funds, hedge funds, mutual funds, and private investors had joined the band with other social investors in providing funding to this sector; regarding microfinance sector as different asset class providing relatively stable investment risk diversification (Di Bella, 2011) and, especially for social investors, providing investment class with socially responsible impact (Kappel et al., 2011; Smith et al., 2007). On the other hand, MFIs were also reaching out to mainstream financial industry to expand their funding source, a move pioneered and supported by major MFIs (Meehan, 2004). Hagen and Kirchstein (2011) pointed out that the growth rate of investment from Microfinance Investment Vehicles (MIVs) had been very high in two-year period prior to the global financial crisis of 2008, which topped at 86% growth in 2007. MIV is private investment funds specialises in channelling funds from investors to MFIs globally, which has been behind the surge of investment into this sector (Reille & Sananikone, 2007).

However, evidence after the global financial crisis which began in 2008 has shown otherwise. Studies found that microfinance sector was not as resilient and immune as it had been perceived to be (Wagner & Winkler, 2013). The opening up of microfinance sector to the international investors had had to some extent integrated this sector more into the mainstream financial world. Rising investments from MIVs and other traditional financial investors had pushed the credit-led microfinance expansion whereby MFIs, especially large mature MFIs, had increasingly capitalised on this funding influx to embark on lending-led expansion (El-Zoghbi et al., 2011; Visconti & Muzigiti, 2009). This increases MFIs dependency toward borrowings from financial investors, which paradoxically suggested as increasing its vulnerability to external financial shocks.

There has also been evidence that the mission drift of MFIs, i.e. in the form of MFIs turning away focus from poor borrowers in the informal sectors toward consumer lending for borrowers in the formal sectors such as salaried employees and small businesses to pursue more return with lower risk, was related to the increasing MFI vulnerability when the crisis hit, since the financial crisis affect the national economy which in turns affect these 'safer' MFI segments (Gonzalez, 2011). Chen et al. (2010) had also observed that a less stringent application of MFI credit technologies in pursuit for growth and return, which in turn intended to attract more investors. Furthermore, Visconti and Muzigiti (2009) and Gonzalez (2011) also stated that food and fuel price increases resulted from the financial crisis in many countries, had triggered higher inflation which significantly affected the survival of many MFI clients.

The severity of 2008 global financial crisis had exposed microfinance sectors to its newly-adopted vulnerability from increasing integration with mainstream commercial financial world and scaling up effort to reach better-off clienteles. Visconti and Muzigiti (2009) and Gonzalez (2011) thus argued that the 2008 global financial crisis had impacted microfinance sector both directly and indirectly. Econometric-based analysis from Di Bella (2011) showed that MFI performance has significant correlation with mainstream financial conditions in the times of the global crisis. Wagner and Winkler (2013) had also proved quantitatively that microfinance sector has become more vulnerable to shocks as it has adopting a cyclical pattern akin to that of mainstream banking sector whereby credit busts will follow credit booms.

Yet, studies showed that even though 2008 global financial crisis had been more severe than previous crises, its effect was not similar to all regions nonetheless. Gonzalez (2011) and Wagner and Winkler (2013) both observed that South Asia was almost unaffected by the global financial crisis, whilst Gonzalez (2011) also found that Eastern Europe, Central Asia, and Latin America were regions that were severely hit by crisis.

On the other hand, there was another sector-specific crisis that hit microfinance sector in South Asia; in 2010 the over-indebtedness and extreme measures by MFIs to pursue repayment had created another crisis in Andhra Pradesh, India. There were also other smaller-scoped crises elsewhere. Indeed, the 2008 global financial crisis was not the only crisis that had challenged microfinance sector performance and tested its vulnerability in the period of 2004 to date; indeed, there have been several regional-scope crises which had challenged MFI's performance albeit with smaller and more isolated effect than the global ones. These regional-based crises were mostly microfinance-specific; they were due to over-indebtedness and repayment problems, e.g. the market overheating and over-indebtedness crises in Bosnia-Herzegovina in 2010, Morocco in 2010, Nigeria in 2010, and Andhra Pradesh India in 2010 (Conning & Morduch, 2011; Gonzalez, 2011; Maes & Reed, 2012; van Rooyen et al., 2012). In addition to these, there were also cases of repayment crises where borrowers collectively forgone the repayment to protest MFIs' high interests and lending mechanism such as in Nicaragua and Pakistan in 2009 (Chen et al., 2010). The more recent regional-scope crisis is the recurrent microfinance crisis in Ghana since 2013 whereby many MFIs have been driven into bankruptcy that prompted continuous bailout by Bank of Ghana to save others (Addae-Korankye, 2014; Boateng et al., 2016). It is intriguing to observe the effect of the volatility in Ghana considering Ghana's position as one of the countries with the most developed and sophisticated microfinance network in Africa.

However, whilst most of the existing studies focus on the effect of financial crisis from commercial lending, there had been no distinction in analysis in regard to the not-for-profit MFIs performance in comparison to the for-profit ones. This study argued the importance of this matter since generally MFIs that have high exposure to commercial lending are mostly for-profit MFIs. The studies that touched this issue to some extent was Wagner and Winkler (2013), who suggested that credit union MFIs (which generally not-for-profit in nature since it caters for members) to be less affected by the financial crisis. However, they did not make distinction between their performances in each region since the results may be different. Moreover, it is interesting to understand that not all credit union are not-for-profit in nature; as an example, MFIs in the legal form of Baitul Maal wat Tamwil (BMT) in Indonesia are formally registered as credit union or cooperatives even though they have for-profit nature in their business. Another example is SACCO (Savings and Credit Cooperative Organization) in Africa which many has for-profit orientation. Therefore, analysing the impact based on legal format is argued to not being sufficient in regard to examining the impact on not-for-profit MFIs.

In line with the main focus of this research, this final study thus focuses in analysing how these global and local crises had affected not-for-profit MFI's total factor productivity in different region globally. The focus herein is on not-for-profit MFIs as it had been confirmed in the first study in Chapter V that not-for-profit shows significant higher efficiency than for-profit MFIs. Moreover, most studies in this topic analyses the effect of the crises solely based on the partial productivity analysis, such as on credit growth and on financial profitability. This study also seeks to analyse the effect of crises to different productivity component(s), by employing the total factor productivity of Circular Malmquist Index based on the hyperbolic non-oriented DEA model in the period of 2003-2013, i.e. five periods prior to and after the 2008 global financial crisis. In so doing, this study will also observe how crises affected for-profit MFIs relative to their own frontier in all but MENA region, where the available data for for-profit MFIs in the dataset are insufficient to build a credible DEA-based analysis. Therefore, in this region, the effect of crises to all MFIs will be observed instead. The comparison is referred to as indirect in this study as for-profit and not-for-profit MFIs will be assessed in their own frontier separately to isolate the effect of crises to each type of MFIs in more thorough manner.

The rest of this chapter is organised as follow: Section VII.2 describes the research questions explored in this study thoroughly, which subsequently followed by the explanations on the DEA specifications, DEA input-output selection and the Circular Malmquist Index in Section VI.3 and on the dataset in Section VI.4. Section VI.5 analysis the results from Circular Malmquist Index for each regions, thereafter followed by the summary and conclusion for this study in Section VII.6.

VII.2. Research Questions, Research Aims, and Research Contributions

This study seeks to assess the total factor productivity growth of not-for-profit MFIs for the period of 2003-2013, i.e. five periods prior to and after the global financial crisis in 2008, in order to provide empirical evidence on the effect of 2008 global financial crisis and other regional crisis to the total factor productivity components of not-for-profit MFIs. Currently, most if not all existing literatures in the topic of microfinance and financial crisis evaluated MFIs without distinguishing between their profit orientations. Consequently, findings thereof generalise the effect of financial crisis to the microfinance sector for both for-profit and not-for-profit MFIs.

For-profit MFIs have been observed to capitalise from commercial lending influx from traditional foreign financial institutions and also to embark in scaling-up effort. On the other hand, not-for-profit MFIs have traditionally perceived to tap more into non- or semi-commercial public funding sources such as government-driven funding (e.g. multi- and bilateral development agency, development programs, and regulators) or foreign Development Finance Institutions (DFIs), i.e. financial institutions owned by government or group of governments who raise private capital for finance project with development objectives (Reille & Forster, 2008; Sapundzhieva, 2010); both of whom typically provide the cheapest funding as opposed to commercial financial institutions who charges the highest rates. In this regard, Sapundzhieva (2010) provides full classifications of microfinance investors and their characteristics. In addition to these relatively low-cost funding sources, not-for-profit MFIs in the form of NGOs and credit union/cooperatives are typically turn to local financing from local financial institutions if it has to tap into commercial lending (Sapundzhieva, 2010).

Thus, the research questions that will be explored in this study are firstly, whether 2008 global financial crisis and/or regional-based crises had affected not-for-profit MFIs in the same magnitude as that toward for-profit MFIs. If indeed the funding sources for not-for-profit MFIs are from cheaper international funding and/or local commercial funding (the latter as opposed to foreign commercial lending), the presumption herein is that the global financial crisis may affect not-for-profit MFIs in lesser magnitude than the effect on for-profit MFIs. This presumption is due to financial crisis may mostly affect not-for-profit MFIs indirectly, i.e. through the worsening economic condition which affect their borrowers, as opposed to both direct and indirect effect on for-profit MFIs, the shortage of their funding after crises and/or the increase of their cost of borrowings.

The second research question to be explored is whether 2008 global financial crisis or regional-based crises that had more profound effects to not-for-profit MFIs' total factor productivity in the period observed.

The final research question is how 2008 financial crisis or regional crisis had affected each components of MFIs total factor productivity. Due to the nature of unbalanced dataset available for microfinance in MIX Market database, this study will assess MFI total factor productivity growth by utilising Circular Malmquist Index; which herein will be based on hyperbolic non-oriented DEA model. As discussed in Chapter IV Section IV.6.3, the MFI total factor productivity growth calculated with Circular Malmquist Index can be decomposed into three components, namely pure efficiency change (i.e. the comparison of MFI technical efficiency from time *t* to time *t+1* barring scale effect – or comparison of their VRS technical efficiency), meta- scale efficiency change (i.e. the ratio the MFIs most productive meta-frontier to its technological meta frontier, for one period relative the prior period), and its technological gap/boundary shift change (the shift in the frontier boundary – calculated as the distance of MFI meta-frontier relative to its technological frontier, presented as this shift at time *t+1* relative to the shift at time *t*). In other words, this study seeks to decompose the effect of external shocks along the period of 2003-2013 on these three components.

Therefore, the first aim of this study is to establish the empirical evidence of the total factor productivity growth of not-for-profit MFIs in six different regions at the time of external shocks, and in so doing assessing the total factor productivity of for-profit MFIs to make indirect comparison. Secondly, it aims to establish empirical evidence based on hyperbolic non-oriented DEA model, which this research had proposed as an adept method in assessing MFI performance in the previous chapter, on the effect of both global and regional crisis to the driver of MFI total factor productivity. Thirdly, this study aims to propose the use of the DEA-based Circular Malmquist Index as an adept measurement of MFI productivity, especially in the face of unbalanced MFI data which have been the case for the current microfinance sector.

This study seeks to make contribution toward to both DEA application and MFI productivity literatures. More specifically, the contribution is aimed toward the regional-based not-for-profit MFI productivity studies, especially that in the period of crisis or other external shocks. The subsequent contribution of the this study is toward the use of DEA-based Circular Malmquist Index to measure the total factor productivity in microfinance studies, considering that the availability of balanced data is still the common prevailing problem in MFI productivity studies. Furthermore, many existing studies in regard to MFI performance during the crisis are still based on partial productivity analysis, such as credit growth, number of borrowers separately. Even the limited DEA-based microfinance productivity studies had only employed the basic FGNZ Malmquist Index. Thus, this study proposes an alternative method, i.e. Circular Malmquist Index based on hyperbolic non-oriented DEA to offer fresh insights to this topic.

VII.3. Methodology and DEA Input-Output Specification

VII.3.1. Methodology

In assessing the MFI productivity over the observed periods, this study is focused on the productivity analysis based on the calculation of MFI overall efficiency using hyperbolic non-oriented DEA model (Färe et al., 1985, 1994) as its measure for performance. The use of hyperbolic non-oriented DEA model in this study is in line with the efficiency methodology in the second study, i.e. that this model is more flexible in MFI performance assessment since it allows DMUs to increase efficiency by simultaneous proportional outputs expansion and inputs saving. As in the second study, the efficiency of not-for-profit MFIs will be measured in six different regions globally. African, East Asia and The Pacific (EAP), Eastern Europe and Central Asia (EECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), and South Asia (SA).

Nevertheless, contrasting with the previous two studies, this study does not further decompose MFI efficiency into social and financial efficiency due to its focus herein in evaluating the overall MFI performance against the global and regional crisis; overall efficiency specification encompasses both its outreach and sustainability objectives since it takes account all factors in MFI transformation process hence corresponding to the total factor productivity calculated with Malmquist index.

In the productivity analysis thereafter, the VRS-based Circular Malmquist Index from Portela and Thanassoulis (2008) and its decomposition as per equation (4.34), (4.35), and (4.36) in Chapter IV is used based on its advantages in dealing with unbalanced data; this is a very important in MFI productivity studies since balanced data availability is still a major challenge in MIX Market database as it is still not as developed as database of banking and capital market sector yet. More detailed properties of this model are discussed at length at Section IV.6.3 in Chapter IV. The VRS basis on Portela and Thanassoulis' decomposition of Circular Malmquist Index corresponds to the MFI study perfectly since many MFIs are still not operating in their MPSS to warrant the use of CRS. The MFIs in the dataset also shows wide different sizes of MFIs, which suggests that scale size may play important role in MFI efficiency.

Moreover, its circularity properties is a desirable properties of a growth index (Giraleas, 2013) since it enables further analysis if some periods is missing in the dataset for a particular DMUs. Indeed, in the dataset for this study, which will be discussed at Section VII.4 below, there are several DMUs with missing periods over the observation periods of 2003-2013 (since the dataset is after all an unbalanced panel). In this regard, the circularity feature of Circular Malmquist Index enables interpolation of proxy for productivity index and its components in missing periods by utilising the compound annual growth rate formula as follows:

$$\left(\frac{\text{next available data after missing year}}{\text{last available data prior to missing year}}\right)^{1/(\text{number of missing years})} - 1 \tag{7.1}$$

To calculate productivity growth for missing periods, the interpolation method will be as follows:

$$\left(1 + \text{productivity growth over missing years}\right)^{1/(\text{number of missing years})} - 1 \tag{7.2}$$

Furthermore, Circular Malmquist Index and its components are converted into estimates of annual growth of productivity and its components, i.e. the growth per year of pure efficiency, meta-scale efficiency, and technological gap, by simple natural logarithm transformation of these indices, as follow:

$$\begin{aligned} \Delta MI_C &= \ln(MI_C) \\ \Delta PEC_C &= \ln(PEC_C) \\ \Delta TGC &= \ln(TGC) \\ \Delta MSC &= \ln(MSC) \end{aligned} \tag{7.3}$$

Specifically, the annual productivity growth denotes by the growth of Circular Malmquist Index from its position in previous year, or ΔMI_C, is estimated by taking a simple natural logarithmic transformation of the MI_C index. Similar treatment is also performed to MI_C components, such as the pure efficiency change PEC_C, *TGC* and *MSC*, i.e. estimating their annual growth by taking natural logarithmic transformation of these three indices.

The aggregate productivity index for each observation year is subsequently calculated by taking the geometric mean of indices from all DMUs in each year (for each index, i.e. MI_C, PEC_C, *TGC*, and *MSC*). On the other hand, the aggregate productivity growth for each index in each observation year is calculated by the arithmetic mean for the the index for each productivity growth of all DMUs in year for each index above. Arithmetic mean is used in the aggregate productivity growth calculation as the growth itself is already a natural logarithmic form of DMUs' productivity index, whilst geometric mean is essentially the average of logarithmic forms of the variables assessed.

VII.3.2. DEA Input-Output Selection

The hyperbolic non-oriented DEA model in this study uses three inputs and three outputs, which is to some extent an amalgamation of the model used in the first study and second study; the three inputs remain the same as in the second study, i.e. assets (A), operational expenses (O), and employee (E) – dropping PAR 30 from input variable as in the second study due to similar argument with the second study. On the other hand, the three outputs used in this study are similar to that used in the first study, i.e. financial revenue (F), inverse of average loan balance per borrower over GNI per capita (I), and borrower (B).

Precisely, interest revenue (Ir) used in the second study to represent sustainability is replaced back herein with financial revenue (F) as in the first study. This is in fact due to the main focus of the second study; interest revenue (Ir) was used as output in the second study as the second study specifically explores the relationship between loan methodology and MFI efficiency, thus the best output variable in representing MFI revenue from loan portfolio and in measuring MFI sustainability related to selected loan methodology is interest revenue. On the other hand, financial revenue consists of revenue from loan portfolio (interest revenue) and other financial assets, such as fee-based income. In this study, the focus is back on the overall MFI productivity in times of crisis, thus financial revenue is used as proxy for sustainability objectives as it incorporates all revenues collected by MFIs. Table 7.1 presents these variables in summary.

Table 7.1: DEA Input – Output Selection Study III

Inputs	Initial	Definition	Usage in literatures	Unit
Assets	A	Asset needed in transformation process	Berger and Humphrey (1997), Bassem (2008), Kipesha (2012) and Gutierrez-Nieto et al. (2009)	USD '000
Operating Expense	O	Expenses related to operations, e..g. personnel expenses, administrative expenses.	Gutiérrez-Nieto et al. (2007), Berger and Humphrey (1997), Gutiérrez-Nieto et al. (2009), Hassan and Sanchez (2009) and Athanassopoulos (1997)	USD '000
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), Berger and Humphrey (1997), Bassem (2008), Hassan and Sanchez (2009), Sedzro and Keita (2009), Kipesha (2012), and Haq et al. (2010)	Numerical

Outputs	Initial	Definition	Usage in literatures	Unit	MFI Objective (Efficiency) Represented
Financial Revenue	F	Revenues from loan portfolio (incl. margin rate in IMFIs loan) plus revenues from other financial assets	Gutiérrez-Nieto et al. (2009) and Hassan & Sanchez (2009).	USD '000	Sustainability (Financial Efficiency)
Inverse of Average Loan Balance (standardised over GNI per Capita)	I	Inverse form of average loan balance standardised over gross national income (GNI). Standardised to represent purchasing power and to remove currency value differences. Used in inverse format as output	Modification from literatures. Gutiérrez-Nieto et al. (2009) use average loan borrower as index together with number of borrower.	%	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 Gross Loan Portfolio loan	Modification from literatures. Most literatures use number of women borrowers, e.g. Cull et al. (2007) and Nghiem et al. (2006).	Numerical	Outreach (Social Efficiency)

As in the previous two studies, mean normalization as per Sarkis (2007) in equation (5.2) in Section V..4 is used in the hyperbolic non-oriented DEA part as data to normalize the wide differences in magnitude of all data for inputs and outputs, i.e. performed by dividing each value in a variable with the arithmetic means of that variable. Mean-normalization procedure was done separately in each region to ensure more uniformity in data range.

VII.4. Dataset

This final study employs unbalanced data from MIX database as of June 2016, consisting data from 1,779 MFIs originating from 110 countries in six regions globally, i.e. Africa, EAP, EECA, LAC, MENA and SA, for the period of 2003-2013. This period is selected to reflect the period of five years prior to and post 2008 global financial crisis to maintain balanced observational period. The observation period cannot be extended to longer period due to limitation of MFI data in MIX database for the period prior to 2003. In the calculation of Circular Malmquist Index as in equation (4.34), (4.35), and (4.36) to measure MFI total factor productivity, a meta-frontier approach is also utilised whereby all MFI data from different periods in each region are assessed against single meta-frontier. The total DMU assessed herein are 10,219 DMUs globally, which will be assessed in each region separately. Table 7.2 provides the breakdown and grouping of the dataset in this study.

The focus of this study is in the productivity of not-for-profit MFIs; however, the productivity of for-profit MFIs is also assessed for indirect comparison. As can be seen in Table 7.2, not-for-profit MFIs accounts for 1,039 MFIs whilst 740 MFIs are for-profit MFIs, or accounts for 5,957 not-for-profit DMUs and 4,262 for-profit DMUs. However, this comparison cannot be established for MENA region due to limited data availability on for-profit MFIs in this region, which can be seen from Table 7.2. For-profit MFIs in this period consists only 63 DMUs from the total 468 DMUs in MENA, i.e, spread out in 2003-2013 periods, suggests that there are only 5-6 DMUs in each year. Since the calculation of Circular Malmquist Index requires the measurement of θ_{jt}^{T}, i.e. the efficiency of DMU_j at time t relative to its actual technological frontier T, the DEA analysis would not have strong discriminatory power in each year's technological frontier from this limited number of MFIs, resulting in almost all DMUs to be fully-efficient. Consequently, especially for MENA region, the productivity of not-for-profit MFIs is indirectly compared to the productivity of all MFIs in this region.

Table 7.2: Study III – Dataset Grouping

MFI Classifications	Africa		East Asia & The Pacific (EAP)		Eastern Europe & Central Asia (EECA)		Latin America & The Caribbean (LAC)		Middle East & North Africa (MENA)		South Asia (SA)		Total Dataset	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
By MFI:														
Not-For-Profit MFI	203	54.57	136	52.31	138	49.29	284	62.28	57	85.07	221	64.24	1,039	58.40
For-Profit MFI	169	45.43	124	47.69	142	50.71	172	37.72	10	14.93	123	35.76	740	41.60
Total	**372**	**100.00**	**260**	**100.00**	**280**	**100.00**	**456**	**100.00**	**67**	**100.00**	**344**	**100.00**	**1,779**	**100.00**
By Number of DMU in Meta Frontier Approach:														
Not-For-Profit	1,046	57.63	661	51.00	810	47.76	1,875	62.07	405	86.54	1,160	60.32	5,957	58.29
For-Profit	769	42.37	635	49.00	886	52.24	1,146	37.93	63	13.46	763	39.68	4,262	41.71
Total	**1,815**	**100.00**	**1,296**	**100.00**	**1,696**	**100.00**	**3,021**	**100.00**	**468**	**100.00**	**1,923**	**100.00**	**10,219**	**100.00**
DMU Data Prior to and Post Crisis:														
Nor-For-Profit MFIs:														
DMU data 2003-2008	651	62.24	347	52.50	503	62.10	921	49.12	224	55.31	662	57.07	3,308	55.53
DMU data 2009-2013	395	37.76	314	47.50	307	37.90	954	50.88	181	44.69	498	42.93	2,649	44.47
Total Not-for-Profit MFIs:	**1,046**	**100.00**	**661**	**100.00**	**810**	**100.00**	**1,875**	**100.00**	**405**	**100.00**	**1,160**	**100.00**	**5,957**	**100.00**
For-Profit MFIs:														
DMU data 2003-2008	468	60.86	357	56.22	474	53.50	512	44.68	32	50.79	325	42.60	2,168	50.87
DMU data 2009-2013	301	39.14	278	43.78	412	46.50	634	55.32	31	49.21	438	57.40	2,094	49.13
Total For-Profit MFIs:	**769**	**100.00**	**635**	**100.00**	**886**	**100.00**	**1,146**	**100.00**	**63**	**100.00**	**763**	**100.00**	**4,262**	**100.00**

As previously mentioned in Section I.1.5.3 and in the previous two studies, a proviso should be established whereby the results of the analysis herein should be appreciated with consideration to the limitation arising from the nature of the voluntary data in MIX Market. Indeed, the nature of the data is a main shortcoming of microfinance research. However, since MIX Market (i.e. the source of dataset in this study) is considered to be the best data clearinghouse for microfinance at the moment, the dataset utilised herein is regarded to be the best sample available in relation to inputs and outputs utilised herein for the regions and periods analysed. This dataset is expected to give a fair representation of the MFIs in the regions analysed. It is worth to note that MIX Market datasets are used in most, if not all, microfinance studies that employ secondary data for country- , regional-, or global-scoped analyses.

VII.5. Analysis Results for Each Region

This section describes the results of total factor productivity (TFP) growth analysis from Circular Malmquist Index and the breakdown of its components for each region to observe which Malmquist Index components that influence the TFP growth; more specifically, whether it is the pure efficiency change PEC_C (the change in VRS technical efficiency) or the technological gap change *TGC* (the VRS frontier shift or the VRS boundary shift) that influence the change in TFP.

The summary of the Circular Malmquist Index and the estimate of its annual productivity growth for not-for-profit and for-profit MFIs are presented in separate summary table (Table 7.3 – Table 7.8) along with line chart for the productivity growth to visualise the annual change along observational period, i.e. in Figure 7.1-7.6. Note that not-for-profit MFIs and for-profit MFIs are assessed separately, i.e. relative to their respective frontiers, so the line chart presented in Figure 7.1 – Figure 7.6 are presented in two separate charts for not-for-profit and for-profit MFIs. However, albeit assessed relative to separate frontiers, the magnitude of productivity measures from these two MFI types are comparable except for pure efficiency change (PEC_C) measure, i.e. the overall Circular Malmquist Index (MI_C) and its frontier shift component (*TGC*) are comparable. Yet, for-profit productivity results are included herein in order to observe as comparison especially in MI_C growth during observation period, i.e. how other MFI types performed in the same period during global and other regional crises.

VII.5.1. African Frontier

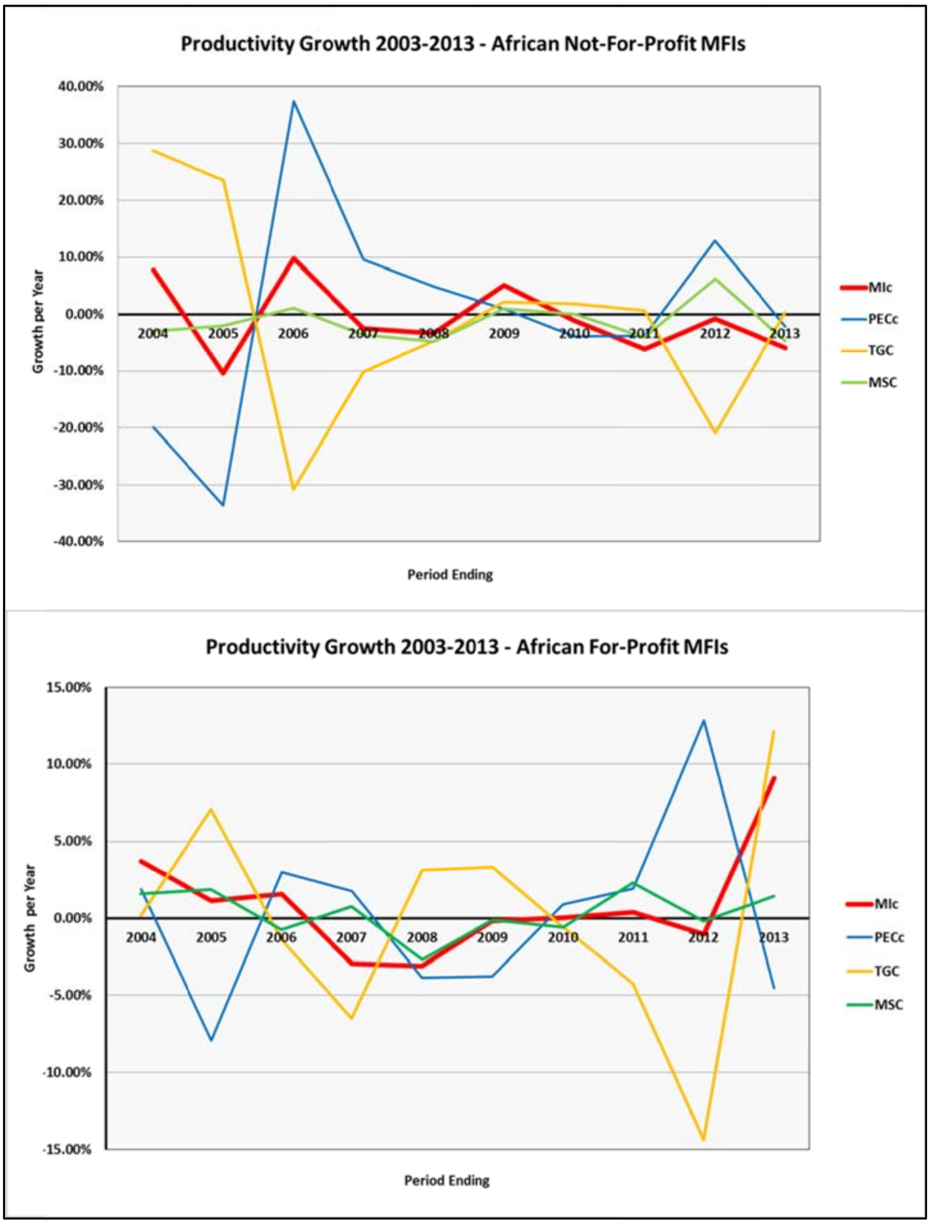
It is observed from the results in Table 7.3 that African not-for-profit MFIs and for-profit MFIs had experienced volatility in productivity prior to the 2008 financial crisis, with more volatility happened to not-for-profit MFIs. In 2004, not-for-profit MFIs enjoyed a TFP growth (MI_C growth) of 7.81%, albeit pure technical efficiency contraction by

19.90%; industry-level productivity (frontier shift) had driven this by strong growth of 28.76% which is attributable to improvement in lending technology amongst not-for-profit MFIs, e.g. introduction of mobile remittance in Kenya which had eventually been emulated in other countries and widely used by MFIs to reduce costs with cashless transaction (United Nations, 2013). In 2005, deeper pure (technical) efficiency drop drove MI_C to fall by 10.45%, even though further positive frontier shift by 23.50%. Very strong improvement in VRS technical efficiency in 2006 by 37.49% pushed the MI_C to grow by 9.83% albeit general fall in not-for-profit microfinance industry productivity signalled by shift in frontier by -30.79%, which dropped even deeper in 2007 by -10.17%. The drop in MI_C and TGC

Literatures, however, showed the periods of 2004 -2005 as periods of fast growth. The difference in result is due to specification in the base DEA model, i.e. since inverse format of average loan per borrower is used as output, the increase in average loan balance per borrower is marked unfavourably in the model since it is judged as decrease in outreach. Indeed, these periods were marked in literatures as periods where average loan balance per borrower in Africa increased considerably due to the expansion of individual loan (scaling up), e.g. in Lafourcade et al. (2005). A combination of volatility in pure efficiency and in industry productivity has driven productivity growth volatility for African not-for-profit MFIs in this period.

However, in the subsequent two periods, i.e. 2007 and 2008, the drop in general industry-level productivity outdone the improvement in technical efficiency and caused the TFP to fall. The drop of general productivity for not-for-profit microfinance industry level, which began in 2006, corresponds with multiple regional-scoped crises befallen in Africa, i.e. post-election turmoil in Kenya and soaring inflation in Ethiopia (two of the largest microfinance markets in Africa) which were followed by food and fuel price hike in Sub-Saharan Africa prior to the global financial crisis (Gonzalez, 2011; Linthorst et al., 2010). Preceding global crisis, there was also countrywide microfinance crisis in Ghana (another one of the largest microfinance markets in Africa) whereby many MFIs collapsed or closed down from insolvency due to overtly aggressive expansion (Boateng et al., 2016). These regional-scoped crises were observed to have shudder not-for-profit MFIs productivity prior to global crisis, thus contributed to the above decline in industry-level productivity.

Figure 7.1: Productivity Growth 2003-2013 – African Not-For-Profit and For-Profit MFIs



On the other hand, relative to their respective frontier, African for-profit MFIs had experienced a modest TFP growth of 3.72%, 1.13%, and 1.55% in three consecutive periods of 2004, 2005, and 2006 albeit a fall in pure efficiency by 7.95% in 2005 that was counterbalanced by the rising industry productivity of 7.07% from the widespread utilisation of mobile remittance as discussed previously. These growths were mostly spurred by the steady moderate growth on pure technical efficiency in 2004-2007. The volatility at industry-level productivity (i.e. frontier shift) for for-profit MFIs in 2004 -2007 period can be observed to be in line with volatility in industry-level productivity for not-for-profit MFIs albeit more moderately.

For-profit MFIs were also affected by the above events in Ethiopia and Kenya and also the fuel and food hike in Sub-Saharan Africa; the TFP (MI_C) fell in period ending 2007 by 2.94% driven by the fall in industry-level productivity by 6.48%. Moreover, the regional crisis in Ghana, which indeed struck not-for-profit MFIs, pushed the fall in TFP due mainly to fall of pure efficiency in 2008 by 3.08% and 3.87%, respectively. These plummeting TFP and PEC_C were sustained in 2008-2009 due to continuing crisis in Ghana, which thereafter intensified when global crisis hit in late 2008. The sustained effects were observed throughout 2010-2012 by the continuous contraction in industry-level productivity (*TGC*).

The 2008 global financial crisis has direct effect to for-profit MFIs since they are more connected to the traditional financial system than their not-for-profit counterparts in regard to resource and funding mobilisation to be on-lent to their borrowers. This result provides empirical evidence to Boateng et al. (2016) that the 2008 financial crisis was not the root cause of the problem in Africa but, rather, embolden it, as well as confirming with Addae-Korankye (2014) regarding for-profit MFIs' interconnection to the global financial world. The shift of focus toward salaried workers in formal sector – i.e. *formalization* (Gonzalez, 2011) – also amplify the crisis effect due to higher elasticity to macroeconomic volatility in this segment from the effect to formal sector.

On the other hand, in the period ended 2009 when global financial crisis started to affect world financial market, African not-for-profit MFIs experienced positive growth in its total factor productivity spurred by marginal growth in both pure technical efficiency and improvement in industry productivity, whilst there was only marginal drop in total factor productivity growth of African for-profit MFIs from positive growth in industry-level productivity. Indeed, the growth in this period was initially perceived by some observers as a proof of microfinance resiliency against global crisis, e.g. Visconti and Muzigiti (2009). However, the effect trickled in the next period for not-for-profit MFIs: the fall of PEC_C in 2010 and 2011 pushed MI_C to plummet by 1.13% and 6.15%, respectively. This may point to the indirect effect of the crisis that inevitably affected poor borrowers who are the target client of not-for-profit MFIs, e.g. macroeconomics turmoil, inflation, and food and fuel price hike (Boateng et al., 2016; Gonzalez, 2011), which eventually affected not-for-profit MFIs (indirect effect) in the form of client drop-out or delinquency.

Table 7.3 Circular Malmquist Productivity Index and Growth Summary – African Region

African Not-for-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0812 (7.81%)	0.8195 (-19.90%)	1.3332 (28.76%)	0.9701 (-3.04%)
2005	0.9008 (-10.45%)	0.7146 (-33.60%)	1.2649 (23.50%)	0.9802 (-2.00%)
2006	1.1033 (9.83%)	1.4549 (37.49%)	0.7350 (-30.79%)	1.0109 (1.08%)
2007	0.9749 (-2.54%)	1.1010 (9.62%)	0.9033 (-10.17%)	0.9644 (-3.62%)
2008	0.9668 (-3.38%)	1.0494 (4.82%)	0.9544 (-4.67%)	0.9536 (-4.75%)
2009	1.0518 (5.05%)	1.0097 (0.97%)	1.0212 (2.10%)	1.0094 (0.93%)
2010	0.9888 (-1.13%)	0.9620 (-3.88%)	1.0180 (1.78%)	0.9996 (-0.04%)
2011	0.9404 (-6.15%)	0.9630 (-3.77%)	1.0070 (0.70%)	0.9598 (-4.10%)
2012	0.9924 (-0.77%)	1.1370 (12.84%)	0.8110 (-20.95%)	1.0640 (6.21%)
2013	0.9427 (-5.90%)	0.9786 (-2.17%)	1.0036 (0.36%)	0.9537 (-4.74%)
Correlation with MI_C 2004-2008		0.5630	-0.3405	0.4845
Correlation with MI_C 2009-2013		0.3298	-0.0558	0.6175

African For-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0379 (3.72%)	1.0189 (1.87%)	1.0016 (0.16%)	1.0161 (1.60%)
2005	1.0114 (1.13%)	0.9236 (-7.95%)	1.0732 (7.07%)	1.0187 (1.85%)
2006	1.0156 (1.55%)	1.0304 (3.00%)	0.9864 (-1.37%)	0.9926 (-0.74%)
2007	0.9710 (-2.94%)	1.0176 (1.74%)	0.9373 (-6.48%)	1.0076 (0.76%)
2008	0.9696 (-3.08%)	0.9621 (-3.87%)	1.0316 (3.11%)	0.9736 (-2.67%)
2009	0.9983 (-0.17%)	0.9630 (-3.77%)	1.0338 (3.33%)	0.9989 (-0.11%)
2010	1.0003 (0.03%)	1.0089 (0.89%)	0.9939 (-0.61%)	0.9941 (-0.59%)
2011	1.0036 (0.36%)	1.0194 (1.92%)	0.9585 (-4.24%)	1.0231 (2.28%)
2012	0.9894 (-1.06%)	1.1368 (12.82%)	0.8661 (-14.37%)	0.9981 (-0.19%)
2013	1.0949 (9.06%)	0.9559 (-4.51%)	1.1286 (12.10%)	1.0145 (1.44%)
Correlation with MI_C 2004-2008		0.1751	0.2604	0.5713
Correlation with MI_C 2009-2013		-0.5622	0.7921	0.4571

The deep plunge of general industry-level productivity in 2012 for both not-for-profit and for-profit MFIs represent the effect of the recurring microfinance crisis in Ghana in 2012, which was the resurfacing of the over-indebtedness and repayment problem in 2008. It contracted the TFP growth albeit strong growth in pure efficiency for both MFI type by 12.8%. The drop in TFP was only sustained by not-for-profit MFIs in 2013 due to the improvement in *TGC* for for-profit MFIs, signalling the start of recovery.

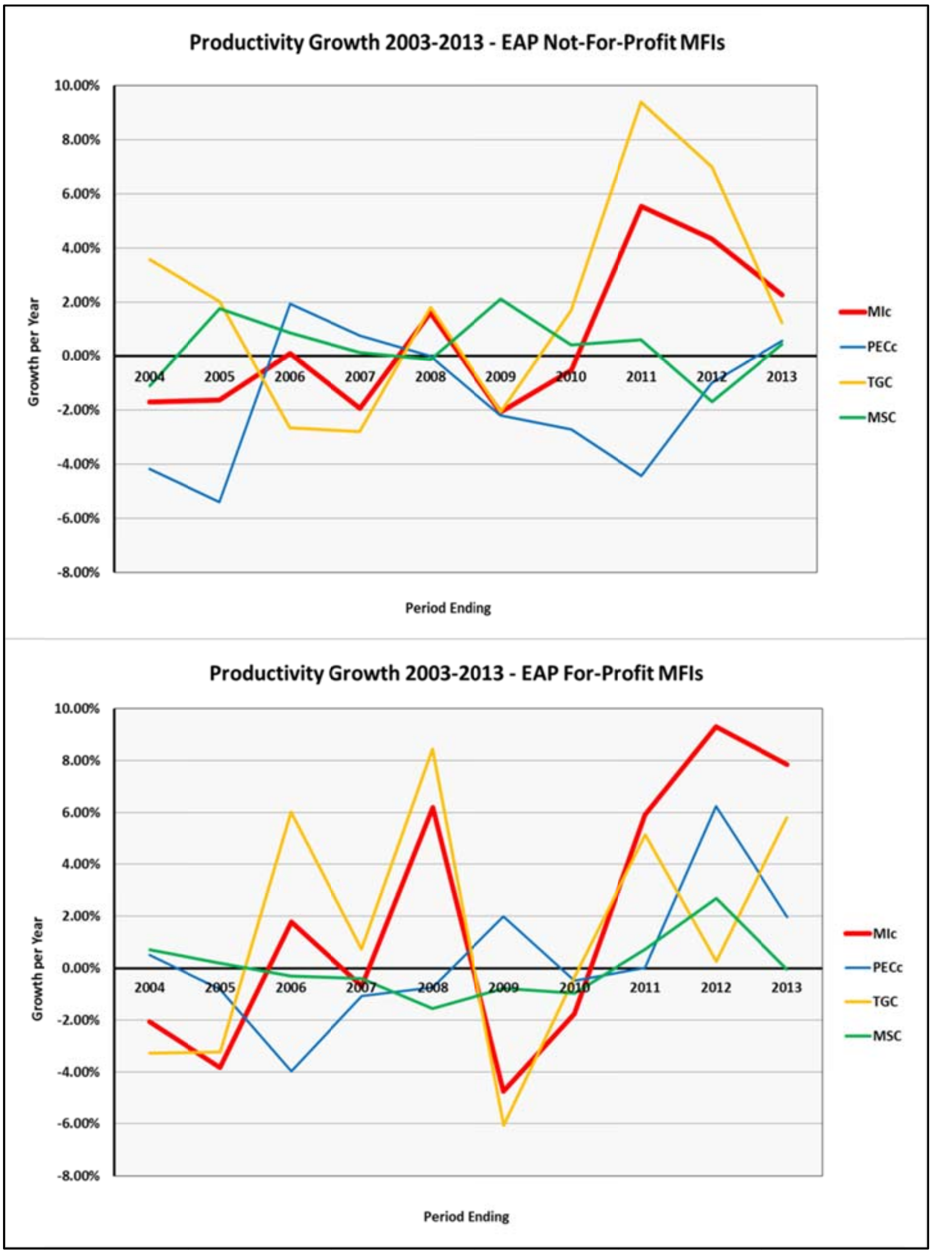
Furthermore, the results from this study at Table 7.3 shows that the MI_C of for-profit MFIs in the dataset was on average correlated strongly with change of productivity at industry level (frontier shift) at 0.7921 after the global financial crisis in 2008, showing that 62.74% the variation in MI_C can be explained by movement in productivity at industry level (frontier shift).

VII.5.2. East Asia and the Pacific (EAP)

In the results for this region listed in Table 7.4, and visualised in Figure 7.2, the volatility in productivity of MFIs in the dataset had been observed prior to 2008 global financial crisis, whereby not-for-profit and for-profit MFIs show similar trend of volatility in TFP growh in 2004-2008, albeit higher magnitude of volatility for for-profit MFIs. The findings for EAP not-for-profit and for-profit MFIs in the dataset show that both MFI types experienced decline in the total factor productivity in the period ending 2004 and 2005 albeit for different reason; MI_C fell for not-for-profit MFIs due to the plummet in technical efficiency (the fall in pure efficiency), whilst the decline for TFP in for-profit MFIs were mostly triggered by the decline in general productivity amongst for-profit MFI industry (the outward shift of the frontier). The fall in PEC_C in not-for-profit EAP MFIs in these periods may be attributed to the increase in average loan balance per borrower over GNI per capita, which is in the DEA model used herein will be considered as reduction in outputs. This might be due to the additional offerings of individual loan, which typically have higher loan balance.

For-profit MFIs experienced negative growth in their pure technical efficiency relative to their respective frontier from period ending 2005 until period ending 2008 in the results although the industry-level productivity had generally been increasing (positive *TGC* growth); the latter due to the inflows of funding from traditional financial investors as debt financing (Gaul, 2010; MIX & Intellecap, 2009). These may indicated that for-profit MFIs could not optimally use the influx of funds available to boost its technical efficiency.

Figure 7.2: Productivity Growth 2003-2013– EAP Not-For-Profit and For-Profit MFIs



On the other hand, not-for-profit MFIs in the dataset during period ending 2006 and 2007 suffered a sustained small drop in productivity at industry level, i.e. continued further shift of the boundary, due to food price hike started in 2005 that squarely hit not-for-profit target customer of poor borrowers (The World Bank, 2009); which eventually affected not-for-profit MFIs in terms of repayment problem, and diminishing deposits (representing indirect effect to MFIs).

In the period prior to global crisis (2004-2008), total factor productivity MI_C of for-profit MFIs were in general correlated very highly with boundary shift *TGC* at 0.9527, which means that 90.77% variation in total factor productivity growth for for-profit MFIs can be explained by the change in industry-level productivity. In the same period, total factor productivity MI_C of not-for-profit MFIs only weakly correlated with change in pure technical efficiency at 0.4938.

This study hereby present different perspectives to EAP MFIs than existing literatures, whereby most literatures recorded generally healthy growth prior to the global financial crisis in 2008-2009 or period ending 2009 for all EAP MFIs without distinguishing between not-for-profit and for-profit MFIs. Besides drawing separation between not-for-profit and for-profit MFIs, this study measures the total factor productivity in a model that incorporates all inputs and outputs based on non-oriented strategy, as opposed to the partial productivity measures used in existing literatures, such as measuring solely credit growth or measuring borrower growth separate from other outputs. Thus, this study cannot confirm Gonzalez (2011) and Gaul (2009) completely that EAP MFIs exhibited impressive growth all in all periods prior to crisis due to different specification.

These drops in MI_C may be explained due to specification of the DEA model as the base analysis herein: one of the important outputs is average loan balance per borrower over GNI per capita which is used in inverse order and is used to represent depth of outreach. As the MFIs in EAP started to introduced (or shift completely to) individual loan which typically has higher average loan balance, then the model will result in lower efficiency due to higher average loan balance will be marked as decrease in outputs. Literatures showed that individual loans predominated in EAP MFIs until 2007, e.g. in Cull et al. (2007).

Table 7.4 Circular Malmquist Productivity Index and Growth Summary – EAP Region

EAP Not-for-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	0.9830 (-1.71%)	0.9592 (-4.17%)	1.0363 (3.57%)	0.9890 (-1.10%)
2005	0.9839 (-1.63%)	0.9474 (-5.40%)	1.0205 (2.03%)	1.0178 (1.76%)
2006	1.0009 (0.09%)	1.0194 (1.92%)	0.9737 (-2.66%)	1.0086 (0.85%)
2007	0.9808 (-1.94%)	1.0075 (0.75%)	0.9724 (-2.80%)	1.0013 (0.13%)
2008	1.0161 (1.59%)	0.9999 (-0.01%)	1.0181 (1.80%)	0.9987 (-0.13%)
2009	0.9794 (-2.08%)	0.9783 (-2.19%)	0.9796 (-2.06%)	1.0213 (2.10%)
2010	0.9948 (-0.52%)	0.9733 (-2.71%)	1.0169 (1.68%)	1.0042 (0.42%)
2011	1.0570 (5.55%)	0.9566 (-4.43%)	1.0984 (9.39%)	1.0061 (0.61%)
2012	1.0443 (4.34%)	0.9900 (-1.00%)	1.0725 (7.00%)	0.9833 (-1.68%)
2013	1.0230 (2.27%)	1.0057 (0.57%)	1.0124 (1.23%)	1.0044 (0.44%)

Correlation with MI_C 2004-2008	0.4938	0.0014	-0.0401
Correlation with MI_C 2009-2013	-0.1248	0.9358	-0.6427

EAP For-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	0.9796 (-2.06%)	1.0050 (0.50%)	0.9677 (-3.28%)	1.0072 (0.72%)
2005	0.9623 (-3.84%)	0.9920 (-0.81%)	0.9682 (-3.23%)	1.0019 (0.19%)
2006	1.0179 (1.77%)	0.9612 (-3.96%)	1.0620 (6.02%)	0.9970 (-0.30%)
2007	0.9931 (-0.69%)	0.9894 (-1.07%)	1.0074 (0.74%)	0.9960 (-0.40%)
2008	1.0638 (6.19%)	0.9926 (-0.75%)	1.0882 (8.45%)	0.9846 (-1.56%)
2009	0.9536 (-4.76%)	1.0203 (2.01%)	0.9413 (-6.05%)	0.9923 (-0.78%)
2010	0.9826 (-1.75%)	0.9953 (-0.47%)	0.9968 (-0.32%)	0.9904 (-0.97%)
2011	1.0608 (5.90%)	1.0002 (0.02%)	1.0529 (5.15%)	1.0073 (0.73%)
2012	1.0975 (9.31%)	1.0645 (6.25%)	1.0026 (0.26%)	1.0273 (2.69%)
2013	1.0815 (7.83%)	1.0199 (1.97%)	1.0597 (5.80%)	0.9995 (-0.05%)

Correlation with MI_C 2004-2008	-0.2793	0.9527	-0.8904
Correlation with MI_C 2009-2013	0.4970	0.7692	0.7869

In two periods succeeding the 2008 global financial crisis, i.e. periods ending in 2009 and 2010, both not-for-profit and for-profit EAP MFI suffered fall in total factor productivity, indicated the effect of the financial crisis since both MFI types drawn debt financing heavily in their expansion (MIX & Intellecap, 2009), which was shown by a fall in *TGC* in 2009, i.e. decrease in industry-level productivity for both MFIs. This was still sustained by for-profit MFIs in 2010, whilst it has marginally recovered for not-for-profit MFIs.

More broadly, the TFP components affected were different for these two MFI types; financial crisis spurred liquidity shortage (supply side) and the macroeconomic upheaval that exacerbated prior food price hike, i.e. affected MFIs' poor borrowers that decrease the interest revenue from repayment (demand side), which collectively drove the plunge of PEC_C in not-for-profit MFIs from period ending 2009 to period ending 2012. This caused MI_C of not-for-profit MFIs to fall in periods ending 2009 and 2010, though later counterbalanced by strong improvement in industry-level productivity (positive shifts of the frontier) from 2011 onward when funds started to pour back into the sector triggering MI_C to grow positively from 2011.

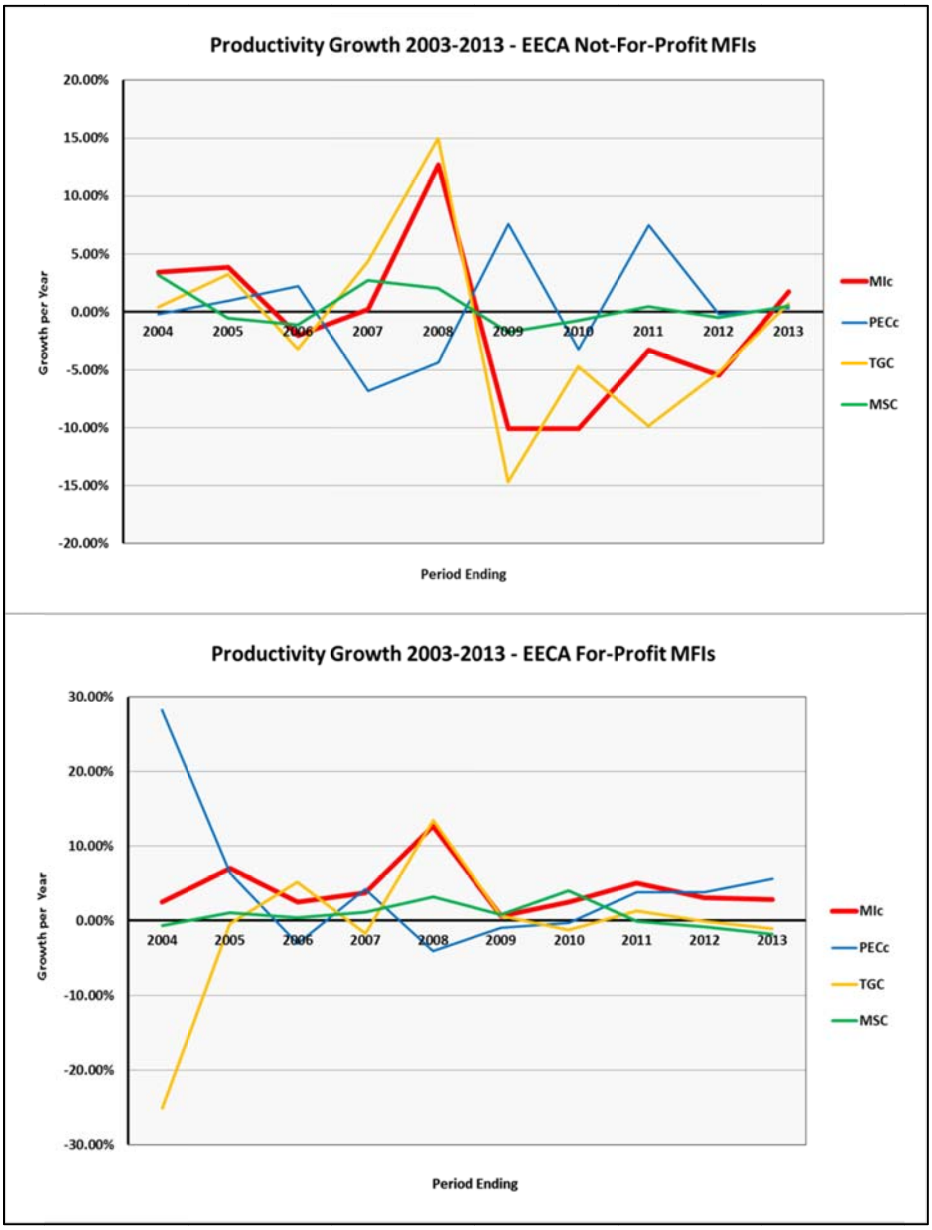
In regard to for-profit MFIs, the financial crisis triggered the plunge in industry-level efficiency (*TGC*) in periods ending 2009 and 2010. Even though both not-for-profit and for-profit MFIs used debt financing heavily, this study found that components that were affected were different for both types of MFIs. The financial crisis affected for-profit MFIs especially on the fall of industry-level productivity *TGC* (supply side). Its PEC_C was only affected marginally, i.e. slowed down in 2010 and then rebounded back.

From periods ending 2011 until 2013, both not-for-profit and for-profit MFIs had recovered and exhibited positive growth in total factor productivity. Although not-for-profit MFIs were still experiencing negative growth in pure efficiency change but these were surpassed by strong increase in industry-level productivity. On the other hand, strong pure efficiency PEC_C growth of for-profit MFIs contributed more toward its strong MI_C growth in 2012. In the period succeeding the financial crisis (2009-2013), MI_C of not-for-profit EAP MFIs showed very strong linear correlation with *TGC* at 0.9358, which means that 87.57% of variation in MI_C can be explained by changes in industry-level productivity. On for-profit MFIs, the correlation of its total factor productivity MI_C to industry-level productivity is still strong at 0.7692 albeit a decrease from that in the five-year prior to crisis. This means that now only 59.17% variation in MI_C that can be explained by change in industry-level productivity.

VII.5.3. Eastern Europe and Central Asia (EECA)

EECA is one of the fastest growing microfinance markets prior to the crisis with Bosnia-Herzegovina as its largest market. This study shows that both not-for-profit and for-profit EECA MFIs generally experienced a continuous positive total factor productivity MI_C growth in the 2003-2008 period prior to crisis, with the only exception of negative TFP growth of -2.05% for not-for-profit MFIs in 2006. Even in the event of a substantial general drop in the industry-level productivity amongst for-profit MFIs in 2004 period of -25.11%, the total factor productivity still grew positively at 2.49% due to impressive 28.23% growth in pure efficiency (PEC_C) relative to its frontier. This large drop in industry-level productivity of for-profit MFIs corresponds to increased costs and very thin profit margin in microfinance banks and credit unions due to competition with NGOs and NBFIs (not-for-profit MFIs), which enjoyed healthy profit margin due to sourcing funds from grants (Pytkowska & Bańkowska, 2004).

Figure 7.3: Productivity Growth 2003-2013– EECA Not-For-Profit and For-Profit MFIs



The pre-crisis findings herein supports literatures, e.g. Tomilova et al. (2011), Gonzalez (2011) and Chen et al. (2010), regarding strong EECA growth in 2004-2008 period. Interestingly, the total factor productivity growth in this period for both MFI types exhibit negative with PEC_C relative to their respective frontiers albeit with small-medium magnitude. On the other hand, the MI_C growth for not-for-profit MFIs was very strongly correlated with the growth at industry-level productivity, *TGC*, at 0.9127, i.e. 83.30% variation in total factor productivity can be explained by industry-level productivity, whilst the MI_C growth of for-profit MFIs had moderate-high correlation with *TGC* growth at 0.6466, where only 41.81% variation of total factor productivity can be explained by the change in industry-level productivity.

Indeed, it can be observed in period ending 2008, the peak of EECA growth just at the brink of the global crisis, both not-for-profit and for-profit EECA MFIs booked a strong MI_C growth of 12.70% and 12.69%, respectively, despite the fall in PEC_C growth relative to their own frontiers. This growth was driven by a strong increase in industry-level productivity for both MFI types (13.47% for for-profit MFIs and 14.99% for not-for-profit MFIs), instigated by the influx of funds from international financial institutions available as on-lent financing to borrowers (Tomilova et al., 2011). Indeed, EECA was one of the most aggressive microfinance markets with its expansion driven by debt financing (Sapundzhieva, 2010). The fall in PEC_C in 2007-2008 for not-for-profit MFIs and in 2008 for for-profit MFIs relative to their respective frontier at the peak of sector growth were driven by the increased over-indebtedness problem in Bosnia-Herzegovina, where the market was very saturated in 2008 due to influx of funds into the sector. Many MFIs competing for clients in a small market prompting multiple lending by clients in Bosnia-Herzegovina, i.e. borrowers take out multiple microloans from multiple MFIs at the same time then unable to repay them. This ultimately increased delinquency and client drop-out (Tomilova et al., 2011).

Following the global financial crisis in 2008, not-for-profit MFIs was hit heavily in period ending 2009 and 2010 when the TFP plummeted by -10.11% and -10.07%, respectively, spurred by the negative *TGC* (decreasing industry-level productivity) and compounded by negative PEC_C in 2010. The frontier contraction was due to the fact that not-for-profit MFIs, such as NGOs, relied severely on commercial debt financing owing to the limited, if at all any, deposit mobilization capability thus post-crisis fund shortage forcing the market to contract (supply side effect). This MI_C and TGC fall for not-for-profit MFIs were continued in periods ending 2011 and 2012 due to macroeconomic turmoil trailing the crisis heavily hit poor borrowers, which intensified in 2010 by the peak of over-indebtedness crisis in Bosnia-Herzegovina (shown by the negative pure technical efficiency growth). This findings are in line with Chen et al. (2010), Gonzalez (2011), Di Bella (2011), and Wagner and Winkler (2013).

Table 7.5 Circular Malmquist Productivity Index and Growth Summary – EECA Region

EECA Not-for-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0351 (3.45%)	0.9979 (-0.21%)	1.0043 (0.43%)	1.0325 (3.20%)
2005	1.0392 (3.84%)	1.0094 (0.93%)	1.0332 (3.26%)	0.9945 (-0.55%)
2006	0.9797 (-2.05%)	1.0225 (2.22%)	0.9681 (-3.24%)	0.9887 (-1.14%)
2007	1.0022 (0.22%)	0.9341 (-6.82%)	1.0445 (4.36%)	1.0275 (2.71%)
2008	1.1354 (12.70%)	0.9574 (-4.35%)	1.1617 (14.99%)	1.0203 (2.01%)
2009	0.9039 (-10.11%)	1.0787 (7.57%)	0.8632 (-14.71%)	0.9825 (-1.76%)
2010	0.9042 (-10.07%)	0.9678 (-3.27%)	0.9539 (-4.72%)	0.9923 (-0.77%)
2011	0.9677 (-3.28%)	1.0775 (7.47%)	0.9060 (-9.87%)	1.0044 (0.44%)
2012	0.9470 (-5.44%)	0.9981 (-0.20%)	0.9493 (-5.21%)	0.9951 (-0.49%)
2013	1.0177 (1.75%)	1.0034 (0.34%)	1.0075 (0.74%)	1.0050 (0.50%)
Correlation with MI_C 2004-2008		-0.3351	0.9127	0.3342
Correlation with MI_C 2009-2013		-0.0180	0.6441	0.8747

EECA For-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0252 (2.49%)	1.3262 (28.23%)	0.7779 (-25.11%)	0.9937 (-0.63%)
2005	1.0725 (7.00%)	1.0654 (6.34%)	0.9955 (-0.45%)	1.0110 (1.10%)
2006	1.0254 (2.51%)	0.9694 (-3.10%)	1.0533 (5.19%)	1.0041 (0.41%)
2007	1.0382 (3.75%)	1.0433 (4.24%)	0.9830 (-1.72%)	1.0118 (1.18%)
2008	1.1353 (12.69%)	0.9602 (-4.06%)	1.1442 (13.47%)	1.0322 (3.17%)
2009	1.0059 (0.59%)	0.9903 (-0.97%)	1.0066 (0.66%)	1.0079 (0.79%)
2010	1.0257 (2.53%)	0.9973 (-0.27%)	0.9876 (-1.25%)	1.0409 (4.01%)
2011	1.0514 (5.01%)	1.0384 (3.77%)	1.0129 (1.28%)	0.9991 (-0.09%)
2012	1.0309 (3.04%)	1.0389 (3.81%)	0.9991 (-0.09%)	0.9915 (-0.85%)
2013	1.0287 (2.83%)	1.0577 (5.61%)	0.9891 (-1.10%)	0.9817 (-1.85%)
Correlation with MI_C 2004-2008		-0.4820	0.6466	0.9170
Correlation with MI_C 2009-2013		0.6477	0.2376	-0.2334

On the contrary, the results herein do not find the 2008 global financial crisis to hit the total factor productivity growth for for-profit MFIs into experiencing negative growth; rather, the financial crisis slowed down the growth in for-profit MFIs in periods ending 2009 and 2010 to 0.59% and 2.53%, respectively, attributed to the fall in pure technical efficiency of -0.97% and -0.27%, respectively, which is mainly a continuation from over-indebtedness problem prior to crisis. In 2010, the industry-level productivity growth indicated by *TGC* only showed decrease of 1.25%. Moreover, in the period after 2010, when Bosnian microfinance crisis hit, the growth of for-profit MFIs' MI_C was significant at 5.01%, 3.04%, and 2.83% in 2011, 2012, and 2013 periods, respectively. These positive growths were driven by positive growth in pure technical efficiency of 3.77%, 3.81%, and 5.61% in periods ending 2011, 2012, and 2013, respectively, relative to for-profit frontier. This result thus requires further investigation. Consequently, this study cannot confirm the above literatures for the case of for-profit MFIs. One possible explanation points to the deposit-taking ability in for-profit EECA MFIs, i.e. the deposit mobilization from clients is a traditional source of funds to be on-lent to their clients for credit unions and microfinance banks (Pytkowska & Bańkowska, 2004) which may help in times of liquidity shortage.

In the 2009-2014 period, total factor productivity growth for not-for-profit EECA MFIs on balance are now only moderately correlated with the *TGC* (r= 0.6441). On the contrary, total factor productivity growth of for-profit EECA MFIs on balance is moderately correlated with pure efficiency change PEC_C (r= 0.6477).

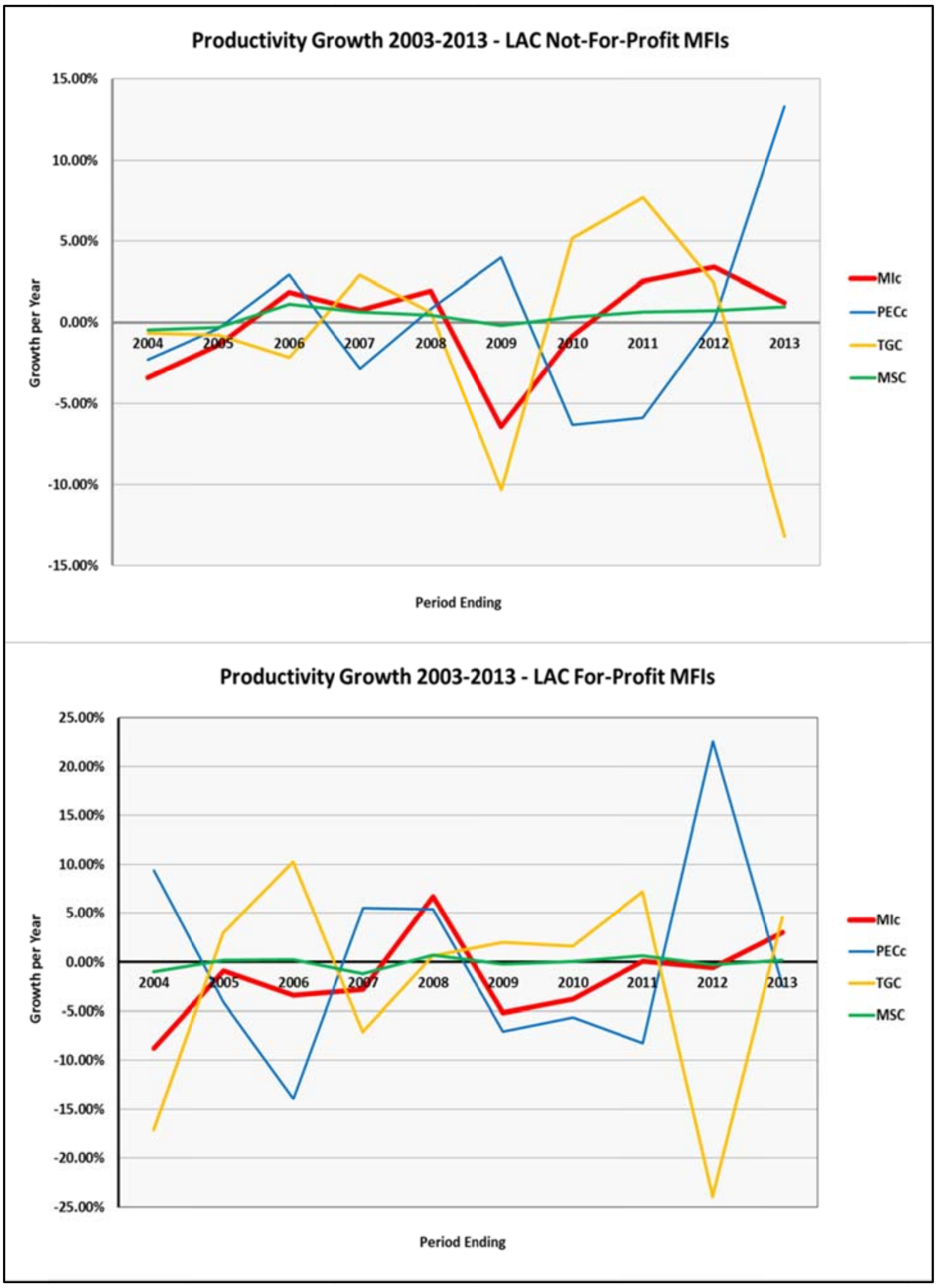
VII.5.4. Latin America and the Caribbean (LAC)

The findings from the total factor productivity assessment in LAC represent a mixture of strong growth and MFI vulnerabilities. Indeed, the beginning of the observation periods finds that both not-for-profit and for-profit LAC MFIs experienced a contraction in total factor productivity growth in 2004, i.e. -3.41% and -8.75%, respectively. This is due to fall in industry-level productivity, which was marginal for not-for-profit MFIs (-0.66%) albeit large for for-profit MFIs (-17.15%). This large contraction in for-profit frontier offset the strong increase in pure efficiency growth relative to its frontier. For both MFI types, the fall in industry-level productivity could be explained by the stagnation of commercial funds for credit expansion, i.e. part of the aftermath of Latin American microfinance crisis in 2000 (Gehrke & Martinez, 2006).

This liquidity crunch eased up in period ending 2005 when fresh commercial borrowings started to pour in for credit expansion, therefore slightly reduced MI_C

contraction to -1.40% (not-for-profit MFIs) and -0.92% (for-profit MFIs). The general industry-level productivity grew positively amongst for-profit MFIs in 2005 and 2006 as a result, but increased competition from banks and NBFIs and their ability to tap more commercial borrowings and investment funds narrowing the room for not-for-profit MFIs to expand.

Figure 7.4: Productivity Growth 2003-2013– LAC Not-For-Profit and For-Profit MFIs



In 2005 and 2006, however, the pure technical efficiency was continuously decreased for for-profit MFIs due to reason specific to the framework of analysis herein: the period of 2005 onward were signified by the deliberate scaling up effort from Bank-MFIs and NBFI-MFIs to reach better-off clients (Gehrke & Martinez, 2006), which, specifically to the DEA model used as basis of the productivity analysis herein, was disadvantageous as one of the outputs representing outreach is average loan balance per borrower over GNI per capita in inverse format (i.e. the lower the average loan balance signifies higher outreach). Due to this specification, deliberate scaling up effort to move to higher (better-off) borrower segment will be assessed as a declining output in outreach efficiency. As the hyperbolic non-oriented DEA model used herein strives for simultaneous proportional outputs expansion and inputs contraction, the PEC_C in 2005 and 2006 for for-profit MFIs exhibited negative growth of -4.10% and -13.92%, respectively, due to the expansion-cum-scaling-up campaign flourishing therein. This pushed the MI_C to fall into negative growth of -0.92% and -3.42% in 2005 and 2006, respectively, despite strong growth in industry-level productivity.

Technological innovations also had been introduced in LAC to increase efficiency thus shifting the technological frontier (*TGC*). In 2006, innovations were introduced in not-for-profit MFIs, e.g. ATM machines in networks of credit unions and cooperatives in Ecuador by WOCCU (World Council of Credit Union) and Red Transaccional Cooperativa, enabling cooperatives' members to make deposits and withdrawal, and similarly in Bolivia. Both were proven to cut transactional costs (Jaramillo, 2013). These 2006 innovations are reflected in the *TGC* growth for not-for-profit MFIs in 2007 and 2008 results, i.e. 2.92% and 0.63%, respectively.

In the period prior to the crisis, period ended 2008, both not-for-profit and for-profit MFI exhibited positive growth in total factor productivity, i.e. 1.95% for not-for-profit MFIs and 6.73% for for-profit MFIs. For for-profit MFIs, this strong growth was driven by strong growth in pure efficiency relative to its frontier, which may due to client expansion and increased interest revenue funded by both deposits and influx of funds. These results partially concurs with literatures suggested strong growth prior to crisis, such as Gonzalez (2011) and Chen et al. (2010) as the growth is limited to this period.

In 2004-2008 period, it is observed that TFP of not-for-profit MFIs (MI_C) is moderately correlated with pure efficiency change (PEC_C) with r = 0.6059. On the other hand, TFP for for-profit MFIs is correlated moderately with VRS boundary shift *TGC* (r = 0.5002).

Table 7.6 Circular Malmquist Productivity Index and Growth Summary – LAC Region

LAC Not-for-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	0.9665 (-3.41%)	0.9773 (-2.29%)	0.9934 (-0.66%)	0.9955 (-0.45%)
2005	0.9861 (-1.40%)	0.9965 (-0.35%)	0.9925 (-0.75%)	0.9970 (-0.30%)
2006	1.0188 (1.86%)	1.0295 (2.91%)	0.9785 (-2.17%)	1.0114 (1.13%)
2007	1.0076 (0.76%)	0.9721 (-2.83%)	1.0296 (2.92%)	1.0064 (0.63%)
2008	1.0196 (1.95%)	1.0084 (0.84%)	1.0063 (0.63%)	1.0045 (0.44%)
2009	0.9375 (-6.45%)	1.0407 (3.99%)	0.9022 (-10.29%)	0.9982 (-0.18%)
2010	0.9918 (-0.82%)	0.9388 (-6.31%)	1.0529 (5.15%)	1.0032 (0.32%)
2011	1.0256 (2.53%)	0.9429 (-5.88%)	1.0801 (7.71%)	1.0066 (0.66%)
2012	1.0347 (3.42%)	1.0014 (0.13%)	1.0248 (2.45%)	1.0072 (0.71%)
2013	1.0124 (1.23%)	1.1426 (13.33%)	0.8765 (-13.18%)	1.0097 (0.96%)
Correlation with MI_C 2004-2008		0.6059	0.1523	0.8962
Correlation with MI_C 2009-2013		-0.1448	0.4946	0.8976

LAC For-profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	0.9162 (-8.75%)	1.0982 (9.37%)	0.8424 (-17.15%)	0.9903 (-0.97%)
2005	0.9909 (-0.92%)	0.9598 (-4.10%)	1.0302 (2.98%)	1.0020 (0.20%)
2006	0.9664 (-3.42%)	0.8701 (-13.92%)	1.1079 (10.25%)	1.0024 (0.24%)
2007	0.9727 (-2.77%)	1.0568 (5.52%)	0.9317 (-7.07%)	0.9878 (-1.23%)
2008	1.0696 (6.73%)	1.0552 (5.37%)	1.0062 (0.62%)	1.0072 (0.72%)
2009	0.9498 (-5.16%)	0.9319 (-7.05%)	1.0204 (2.02%)	0.9977 (-0.23%)
2010	0.9631 (-3.76%)	0.9456 (-5.59%)	1.0162 (1.61%)	1.0007 (0.07%)
2011	1.0007 (0.07%)	0.9212 (-8.21%)	1.0748 (7.21%)	1.0062 (0.62%)
2012	0.9941 (-0.60%)	1.2533 (22.58%)	0.7872 (-23.93%)	0.9971 (-0.29%)
2013	1.0310 (3.05%)	0.9754 (-2.49%)	1.0469 (4.59%)	1.0017 (0.17%)
Correlation with MI_C 2004-2008		-0.0270	0.5002	0.7317
Correlation with MI_C 2009-2013		0.2074	0.0089	0.4400

In 2008 two consecutive events affected the microfinance industry in LAC. LAC MFIs had been plagued by over-indebtedness case since Latin American microfinance in 2000 whereby MFIs competed for borrowers so many of them relaxed the due diligence process; this creates moral hazard where borrowers took multiple loans from different MFIs to pay off loan from one MFI with loan from other MFI(s) or to increase the size of loan they received more than he could afford to pay (Gehrke & Martinez, 2006). In the summer of 2008, the severe over-indebtedness cases coupled with high interest rates cases in Northern Nicaragua sparked the politically-supported "No Pago" (no pay) movement that led to widespread Nicaraguan microfinance repayment crisis. This was then compounded by the global financial crisis in late 2008 that dried up the much needed liquidity from commercial banking for credit expansion. These events drove the negative growth of industry-level productivity for not-for-profit MFIs in 2009 by a massive -10.29% (supply side) initially then the macroeconomic turmoil ensued affected their poor borrowers (demand side) in 2010 (Gonzalez, 2011), which is shown by the negative PEC_C growth relative to its frontier by -6.31%, albeit growth in industry-level productivity in 2010 due to fresh influx of funds. As for-profit MFIs were less reliant toward debt financing (due to deposit-taking capability), the crisis affected their borrowers from the formal sector (demand side), prompting successive negative growth of their PEC_C relative to their respective frontier in 2009-2010. Eventually, total factor productivity (MI_C) grew negatively for both MFI types in 2009 and 2010.

Significant negative growth in in industry-level productivity of for-profit MFIs in 2012 (-23.93%) corresponds to the worsening case of over-indebtedness in Peru, Colombia, and Mexico, where commercial banks competing with MFIs to extend microloans thus saturating the market, watering the profit margin and increasing loan in arrears (Conger, 2014). This was ironically caused by the industry-level productivity of for-profit MFIs that had kept growing positively in 2009-2011 period. The negative growth in industry-level productivity for not-for-profit MFIs in 2013 is perceived as an extension of this event. Thus, in these cases the global crisis exacerbated the inherent problems therein (Chen et al., 2010). The recovery could be observed at period ending 2013.

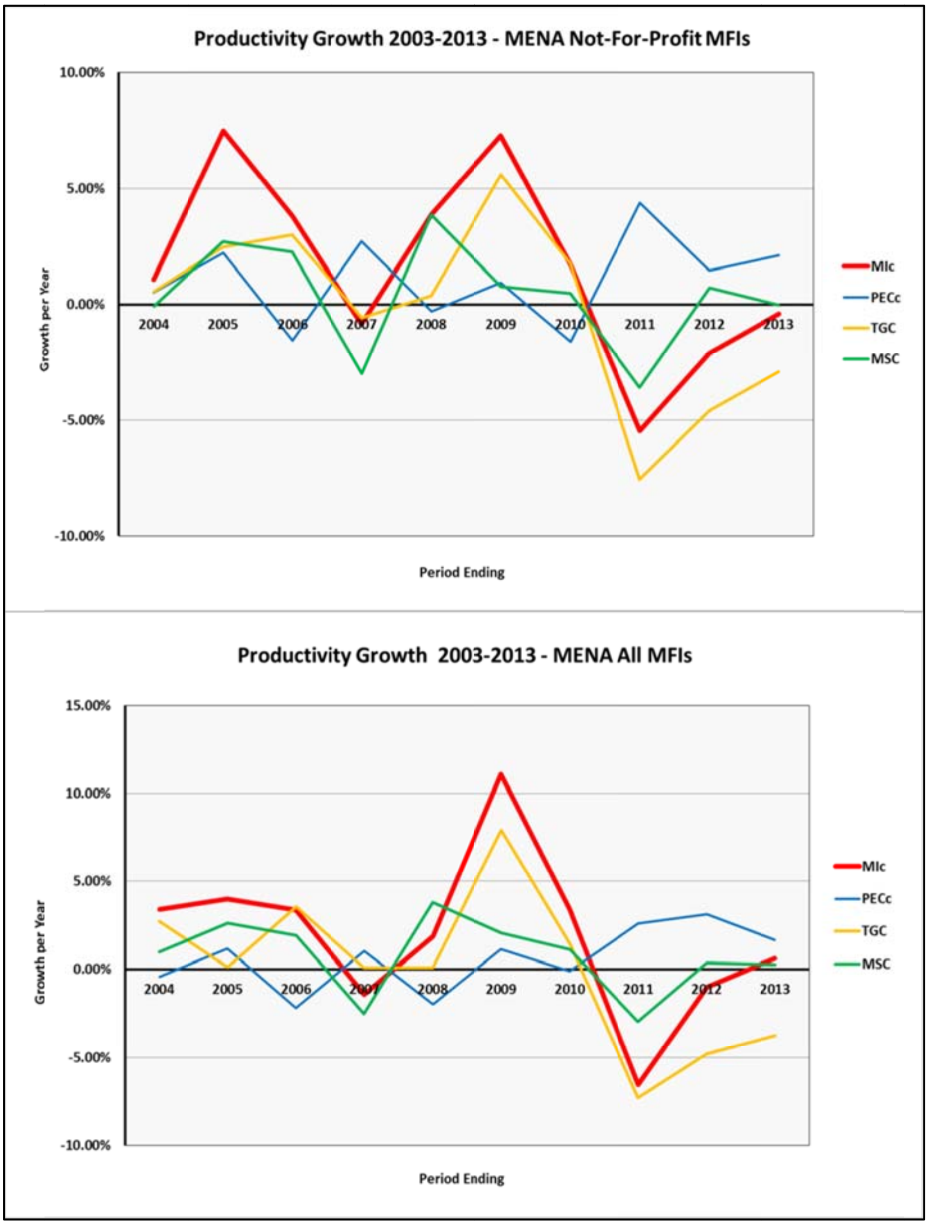
VII.5.5. Middle East and North Africa (MENA)

In this region, this study cannot assess productivity for MENA for-profit MFIs due to the limited number of for-profit MFIs in the dataset. Therefore, the comparison will be made between MENA not-for-profit MFIs and all MENA MFIs in the dataset, particularly in terms of overall Circular Malmquist Index and frontier shift. MENA is the youngest region in the world in terms of microfinance adoption. As in the early stage of growth, the results from this study showed positive MI_C growth in the period ending 2004, 2005, and 2006 for all MFIs and not-for-profit MFIs. In 2006, the pure efficiency for both MFI classifications experienced a negative growth relative to their respective frontiers as the industry therein showed a sign of maturing whilst still maintaining positive total factor productivity (MI_C) growth and industry-level productivity (TGC) growth, i.e. in line with Abdel-Baki and Tazi (2008). These growths had been driven by credit-only NGOs (i.e. the majority of MFIs in MENA) and, specifically, the industry growth in Morocco and Egypt, i.e. two markets that dominated the microfinance landscape in MENA.

However, the total factor productivity growth turned into negative in 2007 period for not-for-profit MFIs and all MFIs by -0.85% and -1.42%, respectively, relating to the fall in industry-level productivity for not-for-profit MFIs by -0.56% and only marginally positive growth in industry-level productivity for for-profit MFIs. These events correspond to the onset of Moroccan microfinance crisis, e.g. with the rise of loan delinquency and multiple lending cases that led into over-indebtedness (Cordier et al., 2010). Literature shows that prior rapid growth in Morocco was essentially an unsustainable growth; pushed by overreached expansion with lacking infrastructure, internal controls, governance (Reille, 2009). In 2006, Moroccan MFIs increase their average loan size by shifting focus toward better-off borrowers, salaried workers in formal sectors (providing consumer lending rather than productive lending), and small businesses (Chen et al., 2010). These scaling-up efforts caused PEC_C of both MFI types, relative to their respective frontiers, to grow negatively in 2006 based on DEA model specification used. It was eventually continue into further weakening of pure technical efficiency change, PEC_C, due to reduced financial revenue from over-indebtedness cases in the period ending 2008, respective to their own frontier.

Interestingly, in the period ended 2009 when the financial crisis spread out globally, the productivity assessment based on the DEA model employed in this study instead demonstrated an increase in total factor productivity growth (MI_C growth) of not-for-profit MENA MFIs and all MENA MFIs by 7.29% and 11.09%, respectively, which were continued to 2010 at lesser rate of 1.70% and 3.39%, respectively. The drivers were the strong increase in industry-level productivity indicated by TGC growth of 5.60% and 7.92%, respectively, in 2009, and 1.76% and 1.44%, respectively, in 2010. These TGC growths correspond to advancement in lending technology introduced in the region such as mobile payment platform *Mobicash* in Morocco in 2009, *MTN Mobile Money* in Yemen, and *M-dinar* in Tunisia in 2010, which streamlined the MFI transactional costs (Pearce, 2011).

Figure 7.5: Productivity Growth 2003-2013– MENA All MFIs and Not-For-Profit MFIs



The *TGC* growths in 2010 for both MFI types outshone the fall in pure technical efficiency PEC_C relative to their respective frontiers, which were the indirect effect of the global financial crisis, i.e. through macroeconomic shocks such as inflation rate (demand side effect). Indeed, even though the financial crisis did aggravated the aftermath of Moroccan microfinance crisis but the results herein indicated that its effect to the sector are relatively limited compared to most other regions. This is due to a fact that MENA MFIs, which mostly consist of not-for-profit, credit-only NGOs (except in Yemen, Syria, and Sudan) have had historically received the fewest cross-border commercial borrowings relative to other regions in the world, and have instead depended upon donations and grants (Djre et al., 2012).

Table 7.7 Circular Malmquist Productivity Index and Growth Summary – MENA Region

MENA Not-For-Profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0109 (1.08%)	1.0052 (0.51%)	1.0055 (0.55%)	0.9992 (-0.08%)
2005	1.0779 (7.50%)	1.0226 (2.24%)	1.0251 (2.48%)	1.0275 (2.71%)
2006	1.0388 (3.81%)	0.9847 (-1.54%)	1.0305 (3.01%)	1.0230 (2.27%)
2007	0.9916 (-0.85%)	1.0277 (2.73%)	0.9944 (-0.56%)	0.9706 (-2.98%)
2008	1.0396 (3.89%)	0.9970 (-0.30%)	1.0038 (0.38%)	1.0393 (3.85%)
2009	1.0757 (7.29%)	1.0096 (0.95%)	1.0576 (5.60%)	1.0078 (0.77%)
2010	1.0172 (1.70%)	0.9840 (-1.61%)	1.0178 (1.76%)	1.0047 (0.47%)
2011	0.9469 (-5.46%)	1.0448 (4.38%)	0.9273 (-7.55%)	0.9648 (-3.58%)
2012	0.9791 (-2.11%)	1.0147 (1.46%)	0.9554 (-4.56%)	1.0072 (0.72%)
2013	0.9960 (-0.40%)	1.0213 (2.11%)	0.9715 (-2.89%)	1.0000 (0.00%)
Correlation with MI_C 2004-2008		-0.1449	0.7596	0.8294
Correlation with MI_C 2009-2013		-0.6127	0.9821	0.7075

MENA All MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0346 (3.40%)	0.9958 (-0.42%)	1.0277 (2.73%)	1.0101 (1.01%)
2005	1.0407 (3.99%)	1.0120 (1.19%)	1.0013 (0.13%)	1.0264 (2.61%)
2006	1.0342 (3.36%)	0.9785 (-2.17%)	1.0362 (3.56%)	1.0194 (1.92%)
2007	0.9859 (-1.42%)	1.0105 (1.04%)	1.0009 (0.09%)	0.9751 (-2.52%)
2008	1.0190 (1.88%)	0.9803 (-1.99%)	1.0011 (0.11%)	1.0387 (3.80%)
2009	1.1172 (11.09%)	1.0115 (1.14%)	1.0824 (7.92%)	1.0207 (2.05%)
2010	1.0345 (3.39%)	0.9989 (-0.11%)	1.0145 (1.44%)	1.0113 (1.12%)
2011	0.9366 (-6.55%)	1.0264 (2.60%)	0.9298 (-7.28%)	0.9708 (-2.97%)
2012	0.9900 (-1.01%)	1.0317 (3.12%)	0.9533 (-4.78%)	1.0038 (0.38%)
2013	1.0062 (0.62%)	1.0167 (1.65%)	0.9631 (-3.76%)	1.0027 (0.27%)
Correlation with MI_C 2004-2008		-0.2811	0.4734	0.7479
Correlation with MI_C 2009-2013		-0.5958	0.9747	0.9081

Another shock in the MENA not-for-profit MFIs observed in the results in Table 7.7 are in the periods ending 2011, 2012, and 2013 for not-for-profit MFIs, where the total factor productivity MI_C continuously contracted by -5.46%, -2.11%, and -0.40%, respectively. In 2011 and 2012 periods, total factor productivity MI_C of all MENA MFIs was also exhibiting negative growth of -6.55% and -1.01%. It can be observed that these falls were driven by the ensuing plunge in industry-level productivity in 2011, 2012, and 2013 for both not-for-profit MENA MFIs and all MENA MFIs. The source of these falls was the Arab spring revolution in 2011, which started in Tunisia then spread toward Egypt, Libya, Bahrain, Yemen, and Syria. In fact, one of the sectors that were suffered the most in the Arab spring movement was the MENA microfinance sector. The entire MENA MFIs at the hotbed of the Arab spring were severely affected in regard to their internal operations, particularly MFIs that were operating in the urban areas. The turmoil made it difficult and costly for MFIs to pursue collection, and even to continue in daily operation for those with link to the government therein (Djre et al., 2012).

Thus, for MENA MFIs in the dataset, regional-based crises such as Moroccan over-indebtedness crisis and Arab spring are observed to have severe and lasting effect than 2008 financial crisis due to the relatively lower integration with international commercial banking sector, and due to impacts of these events on the markets in MENA, i.e. Morocco, Egypt, Yemen, Tunisia, and Syria. Indeed, the results in the period ended 2009 until period ended 2013 indicate that total factor productivity growth (MI_C growth) for not-for-profit MENA MFIs correlated very strongly to the industry-level productivity (technological gap change *TGC*) at $r = 0.9821$, which means that 96.45% of the variation in MI_C can be explained by industry-level productivity (*TGC*). On the contrary, the total factor productivity growth of all MENA MFIs in the periods after the crisis correlated very strongly with both *TGC* at $r = 0.9747$, showing that 95.01% of variation in MI_C can be explained by *TGC*.

VII.5.6. South Asia (SA)

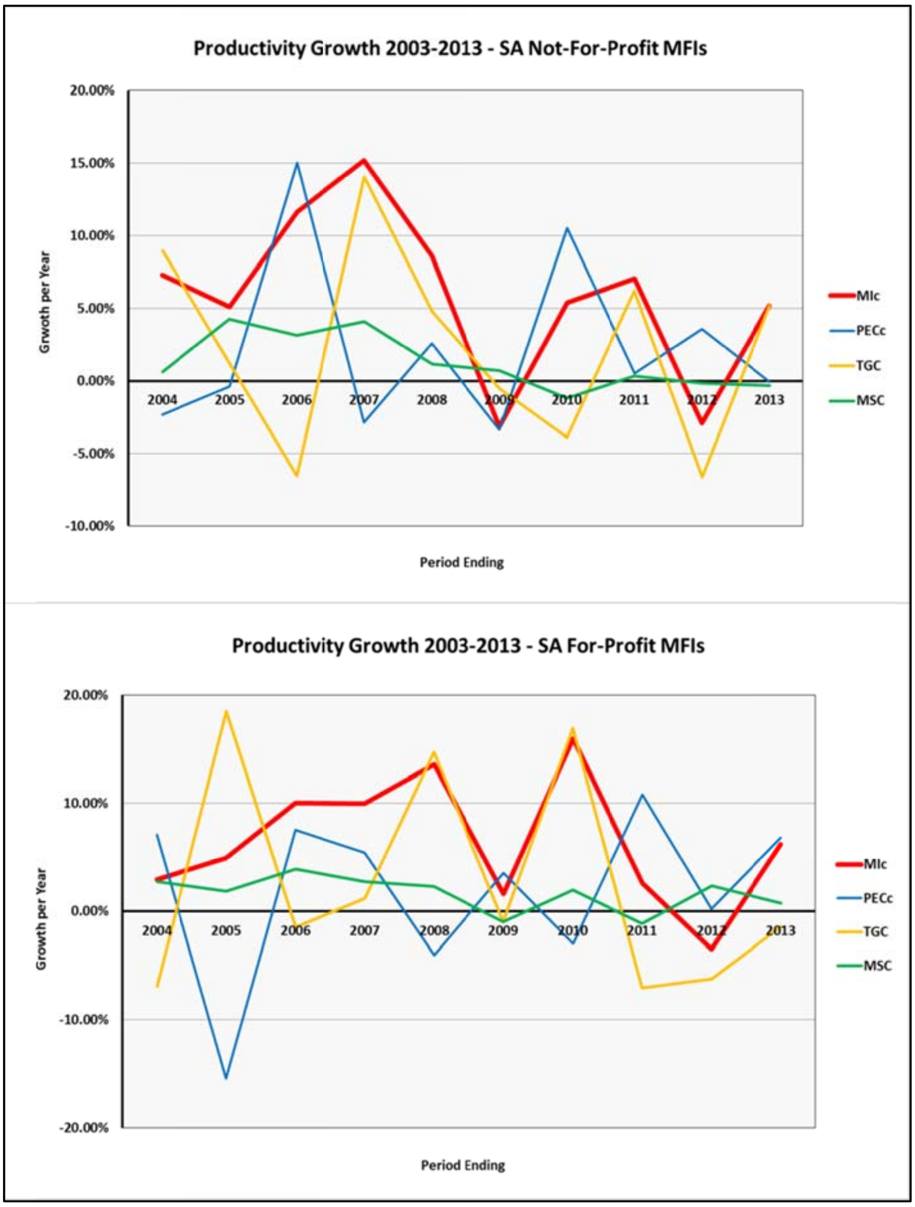
The SA not-for-profit and for-profit MFIs both experienced steady growth in total factor productivity MI_C from the period ended 2004 until the period ended 2008, with notable annual growth in 2006–2008 for both MFI types. In regard to not-for-profit frontier, there were nonetheless contractions in PEC_C growth of not-for-profit MFIs in 2004 and 2005 successively during these periods of strong growths, followed by another contraction in PEC_C growth in 2007. Relative to for-profit frontier, SA for-profit MFIs experienced substantial negative PEC_C growth of -15.49%, which was suffered again in 2008 at -4.02%.

These events marked the onset of first and second regional crisis that hit this region: Andhra Pradesh unethical conduct crisis in 2006 and Pakistan repayment crisis of 2008. Indeed, similar narrative happened herein: the preceding growth in the region was driven by overtly aggressive credit expansion under fierce competition hence lax governance, due diligence, illegal operational practices leading to multiple lending and over-indebtedness (CGAP, 2010; Chen et al., 2010). Prior to that, the contractions of PEC_C for not-for-profit MFIs in 2004 and 2005 and for for-profit MFIs in 2005 marked the introduction of new loan offering (or even shift completely) by several primary MFIs in the region, i.e. individual lending in addition to group lending (Armendariz de Aghion & Morduch, 2005; 2000), which inevitably increased the average loan balance of the loan offered to clients and assessed as unfavourably in the base DEA model herein.

Contrarily, the contraction of industry-level productivity *TGC* in both not-for-profit and for-profit MFIs in 2006 were caused by a crisis in Andhra Pradesh, India whereby ambitious growth was compounded by fierce competition between MFIs. Finally, the district government shut 50 MFI branches due to illegal savings mobilisation, unethical loan collection, high interest rates and profiteering (CGAP, 2010).

The next crisis affected the region was the Pakistan repayment crisis. Negative growth of PEC_C amongst not-for-profit MFIs in 2007 relative to not-for-profit frontier and amongst for-profit MFIs in 2008 relative to for-profit frontier signalled further increase in average loan balance and plummeting of financial revenue due to repayment problem. These correspond to the fact that many borrowers in Central Punjab, which were plagued by over-indebtedness due to multiple lending, were organised by informal agents to initiate movement to refuse payment which is to some extent similar to Nicaraguan crisis. One can refer to Chen et al. (2010), Di Bella (2011), and Gonzalez (2011) for detailed account on this crisis. Uniquely, it happened at the onset of solid growth of industry-level productivity (*TGC* growth) in 2007 and 2008 for both not-for-profit and for-profit MFIs, which attributed to the adoption of new loan technological advancement to drive efficiency and to reduce operational costs, i.e. mobile payment in India, Pakistan, and Bangladesh.

Figure 7.6: Productivity Growth 2003-2013– SA Not-For-Profit and For-Profit MFIs



The repayment crisis in Pakistan reached its height in 2009 whereby the total factor productivity MI_C of not-for-profit MFIs suffered negative growth of -3.16% due to negative growth of PEC_C relative to not-for-profit frontier and of industry-level productivity growth *TGC* by -0.54% (frontier contraction). In regard to for-profit MFIs, this crisis slowed down their MI_C growth to 1.63% by the contraction of their *TGC*.

Table 7.8 Circular Malmquist Productivity Index and Growth Summary – SA Region

SA Not-For-Profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0755 (7.28%)	0.9769 (-2.33%)	1.0941 (8.99%)	1.0063 (0.63%)
2005	1.0522 (5.09%)	0.9961 (-0.39%)	1.0125 (1.24%)	1.0436 (4.27%)
2006	1.1236 (11.65%)	1.1622 (15.03%)	0.9370 (-6.51%)	1.0320 (3.15%)
2007	1.1640 (15.18%)	0.9717 (-2.87%)	1.1510 (14.06%)	1.0418 (4.09%)
2008	1.0900 (8.62%)	1.0263 (2.60%)	1.0493 (4.81%)	1.0116 (1.16%)
2009	0.9689 (-3.16%)	0.9667 (-3.39%)	0.9946 (-0.54%)	1.0072 (0.71%)
2010	1.0553 (5.39%)	1.1109 (10.52%)	0.9619 (-3.89%)	0.9883 (-1.18%)
2011	1.0731 (7.06%)	1.0053 (0.53%)	1.0638 (6.19%)	1.0033 (0.33%)
2012	0.9712 (-2.92%)	1.0363 (3.56%)	0.9361 (-6.60%)	0.9983 (-0.17%)
2013	1.0531 (5.17%)	0.9993 (-0.07%)	1.0536 (5.22%)	0.9966 (-0.34%)

Correlation with MI_C 2004-2008	0.1712	0.2826	0.3000
Correlation with MI_C 2009-2013	0.3340	0.6338	-0.4264

SA For-Profit MFIs	MI_C Index (Growth)	PEC_C Index (Growth)	TGC Index (Growth)	MSC Index (Growth)
2004	1.0297 (2.92%)	1.0734 (7.08%)	0.9334 (-6.90%)	1.0278 (2.74%)
2005	1.0505 (4.92%)	0.8565 (-15.49%)	1.2031 (18.49%)	1.0189 (1.88%)
2006	1.1055 (10.03%)	1.0786 (7.57%)	0.9854 (-1.47%)	1.0397 (3.89%)
2007	1.1049 (9.98%)	1.0560 (5.45%)	1.0118 (1.17%)	1.0278 (2.74%)
2008	1.1456 (13.59%)	0.9606 (-4.02%)	1.1588 (14.74%)	1.0233 (2.30%)
2009	1.0164 (1.63%)	1.0360 (3.54%)	0.9905 (-0.96%)	0.9905 (-0.95%)
2010	1.1729 (15.95%)	0.9704 (-3.00%)	1.1847 (16.95%)	1.0201 (1.99%)
2011	1.0265 (2.61%)	1.1139 (10.79%)	0.9315 (-7.09%)	0.9890 (-1.11%)
2012	0.9655 (-3.51%)	1.0025 (0.25%)	0.9398 (-6.21%)	1.0241 (2.38%)
2013	1.0644 (6.24%)	1.0706 (6.82%)	0.9858 (-1.43%)	1.0076 (0.76%)

Correlation with MI_C 2004-2008	0.0886	0.2794	0.2020
Correlation with MI_C 2009-2013	-0.3607	0.9123	0.2052

The findings showed that in 2010 the TFP growth of both MFI types had already recovered back to positive strong growth. In the case of not-for-profit MFIs, the driver for this growth was strong PEC_C growth relative to its frontier, whilst the driver for for-profit MFIs was the strong positive growth in industry-level productivity (*TGC*) of 16.95%. Literatures attributed this strong *TGC* growth to more widespread initiative of branchless banking through over the counter method or mobile-based payment and withdrawal since 2010 (Pakistan Microfinance Network, 2014), which shown to have larger impact on for-profit MFIs.

However, Table 7. 8 observed subsequent drop of industry-level productivity in 2011 and 2012 for for-profit MFIs and in 2012 for not-for-profit MFIs, which caused a slowdown in 2011 TFP growth and eventually a negative TFP growth in 2012. These contractions correspond to a second, more damaging crisis in the region, i.e. the second over-indebtedness crisis in Andhra Pradesh, India in late 2010. India is the fastest growing market in the SA region and Andhra Pradesh is the centre of microfinance growth in India. Thus, this repayment crisis hit the epicentre of microfinance growth in SA region in a more massive level than the first one in 2006, and quickly felt across the region. Again, the narrative is similar but in a higher scale: overstretched growth, fierce competition, and loan-related staff bonus system had driven poor governance and due diligence which led to borrower's over-indebtedness. Thereafter, when loan repayment was low, MFIs staff embarked on unethical collection. Thus this case gained political weight when local government issued tighter regulation to MFIs and sparked similar scrutiny elsewhere (CGAP, 2010; Shyamsukha, 2011). The contraction of industry-level productivity growth for for-profit MFIs was sustained until 2013.

Indeed, in SA region, it can be observed that regional-scoped crises with roots in overt expansion and over-indebtedness affected MFIs more than 2008 global financial crisis, thus concurring with literatures (Di Bella, 2011; Gonzalez, 2011). In the period ended 2009 to the period ended 2013, the total factor productivity MI_C growth for not-for-profit SA MFIs is correlated moderately at r = 0.6338 with industry-level productivity *TGC*; on the contrary, the MI_C growth in for-profit SA MFIs correlated very strongly with industry-level productivity TGC, at r = 0.9123, which means that 83.23% of variation in MI_C can be explained by industry-level productivity *TGC*.

VII.6. Discussion

From the results of total factor productivity analysis, the following conclusions can be presented.

(1) Microfinance sector had been previously regarded as a sector with immunity against external shocks from global economic and financial volatility due to its business nature with niche customer segment. This reputation had also come from its ability to escape from the 1997 East Asian currency crisis and 2000 Latin American crisis unscathed. Due to this reputation, microfinance had turned into separate asset class for risk diversification of mainstream financial investors, offering attractive returns and social purpose. On the other hand, many MFIs had embraced commercial lending as means to grow their funding base in order to expand their operation and outreach.

Paradoxically, opening up microfinance to mainstream investors later denies microfinance sector from its special immunity; as it has becoming more dependent toward commercial funding from mainstream financial sector, it has becoming increasingly integrated with the mainstream financial sector. Thus, microfinance sector has shown similar boom – bust cycle as per mainstream financial institutions.

This study presents empirical evidence that microfinance sector that have been opened up to commercial funding, including not-for-profit MFIs, could not evade from the effects from external macroeconomic and financial shocks, both directly from the effects of the shocks toward its supply side or indirectly from the effects of the shock toward its demand side. Specifically, this study observes that microfinance institutions globally, with the exception of that from South Asian region, had been affected by the 2008 global financial crisis both directly or indirectly, yet in different magnitude. This study thus concurs with literatures such as Gonzalez (2011) and Wagner and Winkler (2013) stating the increasing similarity in microfinance business cycle with the mainstream financial industry in general.

(2) In relation to the above point, this study found that not-for-profit MFIs have mostly been affected by external shocks such as 2008 global financial crisis and other regional-based crises in similar fashion with for-profit MFIs provided that they have similar exposure and/or dependency toward commercial funding, and provided that they lack proper strategy in expansion and governance. It is argued from the study

result that the latter are more decisive than the profit orientation of MFIs. The initial presumption that not-for-profit MFIs are immune from external shocks such as 2008 global crisis is thus rejected.

(3) Nevertheless, the results in this study also presents empirical evidence that even though the 2008 global financial crisis affected not-for-profit MFIs as well as for-profit MFI in all regions but South Asia by almost similar pattern, it was not a root cause of the problem in most of the regions observed; rather, the 2008 global financial crisis had served to aggravate the inherent problem that had been embedded in the region or to intensify the effects from regional-scoped financial problem.

This study provides empirical evidences that MFIs in Africa and MENA are more affected by regional-based crises and turmoil due to their MFI's relative detachment from commercial lending. On the contrary, EECA, LAC and EAP regions were hit directly due to their heavy exposure to commercial lending. Yet, this study still found that 2008 crisis did more to aggravate the inherent problem in EECA and LAC. Consequently, this study supports empirical evidence to Chen et al. (2010) recognising regional-scoped crisis as root cause of microfinance turmoil to date.

(4) This study support argument that not-for-profit MFIs, and also for-profit MFIs in this regard, can rebuild its shock-resistant immunity against external shocks if and only if they can reduce their dependency toward commercial borrowings and explore other means of funding as well as ability to mobilise deposits that can be used to fund their operation, as in the cases with credit unions and even rural banks in Vietnam, Indonesia, and Philippines where most of the expansion were funded by deposits. Equally important herein is prudent expansion strategy from MFIs, i.e. pursuing gradual expansion backed by proper MIS infrastructure and well-trained loan officers. Loan remuneration system based on loan produced needs to be revisited as it had been observed as source of over-indebtedness cases in many markets.

The findings about perilous relationship between MFIs and commercial borrowing in this study support one of the findings from the second study in Chapter VI that commercial borrowing does not have significant relationship with financial efficiency in African, EAP, EECA and SA frontiers so that increased exposure toward commercial borrowing does not necessarily lead to increased interest revenue from additional loans it produced.

Proper government regulation in regard to microfinance operation from policymakers/governments is also imperative to avoid overtly-high interest rates, profiteering and unethical lending and loan collection.

(5) This study observed that MFIs authorised to mobilise deposits, as in the case in LAC for-profit MFIs, can utilise the deposit to bridge external funding shortage in the event of external crisis and to cover delinquency risk, which eventually build fundamental industry-level resistance to external crisis and preserve financial revenue.

(6) This study found that most of the regional-based crises and volatility were instigated by over-ambitious expansions, uncontrolled competitions, lack of governance and due diligence, all of which lead to over-indebtedness problem. Thus, this study endorses MFI regulation as way to avoid crisis in the future, even though empirical results in second study and many literatures do not find MFI regulation to necessarily correlate with higher efficiency.

(7) By employing DEA-based Circular Malmquist Index in assessing total factor productivity analysis based on Portela & Thanassoulis (2008), this study is able to observe the effect of 2008 financial crisis and other regional-based crisis in total factor productivity and in different components of the total factor productivity measures, which is found to be in line with events/shocks/crises recorded in literature.

This study presents empirical evidences from six regions globally that external shock with direct impact to MFIs (in supply side) will affect industry-level productivity represented by the frontier shift (*TGC*) even before the impact is materialised in the downfall or slowdown of total factor productivity measure (MI_C). Similarly, the external shock with indirect impact to MFIs (by impacting the demand side, i.e. clients) will affect the pure technical efficiency change PEC_C.

(8) Since the hyperbolic non-oriented DEA model serves as the basis for Circular Malmquist Index herein incorporates outputs that represent both outreach and sustainability objectives, some of the findings in this study are different than the partial productivity measures used in existing literatures in regard to the impact of 2008 financial crisis to microfinance.

More specifically, since one of the outputs in this study is average loan balance per borrower over GNI per capita, which is used in inverse format, a scaling-up effort from MFIs by increasing average loan balance by pursuing better-off borrowers or borrowers from formal sector will be regarded as a decrease in outputs. Since scaling-up and formalization had been the source of many microfinance problems in the regions observed, then the total factor productivity (MI_C) calculated from this model can serve as early warning of future problem. Thus, this is one of contributions of this study to MFI productivity studies.

(9) This study observes that the total factor productivity MI_C in the period prior to and/or after 2008 financial crisis in some regions correlates strongly to total factor productivity component, more specifically to industry-level productivity *TGC*. In this condition, one can observe component that on balance influences the variation in MI_C and its magnitude of influence, since the size of MI_C variation explained by this particular component can be calculated from by taking the squared form of the correlation coefficient. However, this may be substantial if and only if the correlation is strong.

Chapter VIII: Summary and Conclusion

VIII.1. Summary

VIII.1.1. Microfinance: Dual Objectives Trade-offs, Efficiency, and Productivity

Microfinance is one of the tools in global poverty alleviation effort with dual bottom objectives in its operation, i.e. the objective of outreach to the poorest, i.e. 'the unbankable', and objective of financial sustainability in order to stay in operation for long without threat of bankruptcy. Thus, microfinance institution takes two roles: as social agent in poverty alleviation and as financial institution that have to maintain its viability to stay in operation, therefore place itself between poverty welfare scheme and traditional financial institution. Due to these seemingly contradictory objectives, a notion of trade-off is perceived thereon i.e. outreach can only be attained at the expense of sustainability, prompting two major approaches in microfinance evaluation: institutionalist approach focusing on sustainability and welfarist approach focusing on deepening outreach. The trade-offs between dual objectives, these two approaches and other conceptual descriptions on microfinance are explored in Chapter II.

Given important roles of microfinance in economic development and empowerment of the poor globally, a rigorous performance evaluation is imperative to ensure the success of the programme. Notwithstanding these complex and often conflicting dual objectives, traditional financial indicators that are widely used to assess microfinance performance is indeed insufficient to evaluate microfinance's entire performance due to partiality problem; as each ratio or indicator assesses the performance of one selected input over one selected output, it is insufficient to draw conclusion about overall performance in the case whereby an indicator showed different or contrasting result with other indicator which is based on different components. Performance evaluation based on single indicator therefore risks overlooking substitution and interaction between several performance measures (Bogetoft & Otto, 2011; Zhu, 2003). Microfinance requires a comprehensive performance measurement method that can evaluate these different objectives together. Moreover, it needs a measurement method which enables straightforward comprehensive performance benchmarking sans aggregation problem.

Efficiency, defined as the optimal utilisation of available inputs in transformation process to produce outputs (Thanassoulis, 2001), is thus proposed as an adept method in evaluating performance of MFIs in regard to the dual objectives as it is able to measure both social and financial missions of microfinance comprehensively. However, as opposed to the widely used efficiency ratio/indicator approach, the word "optimal" thereto implies that the utilisation of available inputs to produce outputs in a unit is compared to a benchmark performance of a best-performing unit. Thus, the efficiency herein is argued as relative concept. The commonly-used efficiency concept as some forms of efficiency ratio/indicator firstly suffer from the same partiality problem; secondly, as it is usually compared to average industry performance, it ultimately means that it is compared against mediocre industry performance as benchmark. Chapter III explores the concept of efficiency in the context of microfinance thoroughly.

Thus, what is proposed herein is a modern frontier-based efficiency assessment, i.e. modern benchmarking method in which relative efficiency of a unit is compared to a benchmark frontier representing the best-practice or technology that is created from all the units in the dataset. This method warrants that the utilisation of inputs into outputs in a unit will be assessed against the best performing units in the industry which are located at the frontier. From the perspective of efficiency, the social and financial objectives of microfinance are viewed as its social and financial efficiency, i.e. the performance of a unit in regard to these dual objectives will be assessed relative to the best performing units in the same region or frontier. Therefore, it is a relative rather than absolute performance, which means that it is possible to achieve both these objectives concurrently.

Productivity assessment of microfinance is also an important to be assessed to warrant that the performance over time of an MFI is going in the right course. Similarly, the productivity measures that are widely used are based on ratio approach, i.e. they are basically partial productivity measures. Therefore, these measures suffer the same partiality and aggregation problem as efficiency measures based on ratio approach. Moreover, the commonly-used ratio-based productivity measures are overlapping with efficiency measures, which is conceptually incorrect. Chapter IV discusses the productivity concept at length. There is a need for total factor productivity measurement for microfinance sector; one that can capture the productivity of all factor of production.

VIII.1.2. Data Envelopment Analysis (DEA) and DEA-based Circular Malmquist Index

One of the primary frontier-based efficiency assessment methods proposed herein for the case of microfinance is Data Envelopment Analysis. DEA constructs frontier of efficient decision-making units (DMUs) from the dataset that envelops all the DMUs in the dataset, as production possibility frontier, to which the performance of all the DMUs in the dataset will be assessed. As the primary method of non-parametric frontier-based efficiency measurement, its advantage over the parametric (econometric-based) efficiency measurement method is the absence of requirement for a priori assumption regarding production function and the fact that efficient frontier herein is created from the actual DMU in the dataset. The latter means that DMUs in the dataset can emulate the actual performance of the fully-efficient DMU with similar characteristic to which they are benchmarked, as opposed to the efficient frontier created from econometric modelling that is essentially a hypothetical average line that fitted to the DMUs in the dataset. The concept of DEA is explored in details in Chapter IV.

Consequently, this study proposes the use of hyperbolic non-oriented DEA model to assess the efficiency of microfinance. This model enables the efficiency measurement of DMUs without forcing DMUs to be assessed based on dichotomy of either uniform strategy of output-maximisation or uniform strategy of input-minimisation. Rather, this model allows the proportional output-expansion and input-contraction simultaneously, which is argued to be more realistic. This model had never been used in microfinance context before, thus it is one of the contributions of this research to the DEA and microfinance literatures.

In regard to total factor productivity assessment, this study proposes the use of DEA-based Circular Malmquist Index as an adept productivity analysis suitable for microfinance context. One of the problem in microfinance is the often the lack of unbalanced historical data. The sector is still relatively young and it is still not as strictly regulated as the traditional banking sector, especially in terms of periodical and standardised reporting requirement. The single primary global database for microfinance, MIX Market, collects the data from global MFIs on voluntary basis. Therefore, historical balanced data is still big issue in this sector. Circular Malmquist Index is thus proposed as it enables the total factor productivity measurement under the condition of unbalanced data. It also has the advantage in its circularity properties, which is a desirable property in an index, i.e. linking productivity in one period to the subsequent period. In this study, the Circular Malmquist Index is based on hyperbolic non-oriented DEA model. From the use of Circular Malmquist Index, interesting findings are found that can be studied in detail in Chapter VII.

VIII.1.3. Efficiency and Productivity of Not-For-Profit MFI, and Research Focus

This research focuses on the efficiency and productivity of not-for-profit MFI. This focus is chosen because not-for-profit MFI is the driver of microfinance growth in many regions, e.g. in MENA, LAC, SA, and Africa regions. Not-for-profit MFIs are also considered in microfinance literatures to have more focus on the outreach to the poorest borrowers, in line with welfarist approach. Since the *raison d'être* of microfinance is outreach to the poor to lift them out of poverty, then it is imperative to focus more in improving the performance of not-for-profit MFIs as the impact to the lives of the poor will be more significant. Moreover, not-for-profit MFIs are mostly unregulated and not authorised to mobilise deposit. Therefore, this study aims to contribute to the improvement in this sector.

This research will focus on the efficiency and productivity of not-for-profit MFIs in the six different regions separately, i.e. Africa, East Asia and the Pacific (EAP). Eastern Europe and Central Asia (EECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), and South Asia (SA), so that improvement of each region can be assessed. This research is undertaken in three interconnected studies: the first study in Chapter V is served as litmus test in regard to the different scheme of Islamic and conventional microfinance; i.e. it assesses whether Islamic microfinance has significant performance differences with conventional microfinance that warrant separate assessment in the subsequent study, the second study in Chapter VI explores the overall, social, and financial efficiency of not-for-profit MFIs in six regions, the relationship of loan method and also other factors to efficiency of not-for-profit MFIs. The final study in Chapter VII analyses the productivity of not-for-profit MFIs in the period of 2003-2013 in the times of external shocks such as 2008 global financial crisis.

VIII.1.4. First Study: Efficiency of Islamic and Conventional Microfinance Institution

The first study in Chapter V firstly assesses the overall, social, and financial efficiency comparison between Islamic and conventional microfinance institutions in three regions, i.e. MENA, SA, and EAP, which was chosen because these regions are where most of IMFIs in the MIX Market dataset located. However, due to the limited availability of the IMFIs in MIX Market dataset with equally limited balanced historical data, the balanced data comparison can only be made for the period of 2009-2010. There are not many IMFIs in MIX Market dataset prior to 2009. It is observed that IMFIs do not have significant differences in performance with conventional MFIs, at least at the current data availability of IMFIs in MIX Market. Indeed the study found that IMFIs have higher financial efficiency but lower social efficiency in MENA but the results from SA and EAP could not be generalised due to limited number of IMFIs in the dataset. Therefore, for the second and third studies, separation between Islamic and conventional MFIs cannot be undertaken at the moment; rather, the subsequent studies focus on the not-for-profit MFIs in general.

Literature review and anecdotal observations later revealed the agency problem to be one of the root causes of this gap in performance; IMFIs generally uses murābahah in their scheme, which was presented in Chapter II. In the original form of this scheme, in-kind financing is extended as opposed to monetary loan, which is intended to avoid loan misuse. However, most of the IMFI field operatives extend monetary loan instead for simplicity, thereby annul the conceptual differences and the objectives.

The first study observes that not-for-profit MFIs indeed showing significantly higher efficiency than for-profit MFIs. This finding is somewhat intriguing since many of MFIs in in EAP are for-profit. This finding thus boosts the argument to focus on not-for-profit MFIs. Other contributions in this study are firstly the proposition of the social and financial efficiency specifications to observe specifically at how MFIs perform in regard to its objective in isolation. These social and financial efficiencies will be the inseparable companion to overall efficiency of MFIs to achieve the comprehensive picture of MFI performance. Secondly, this study introduces the SFE Matrix that is used to map the social and financial efficiency performance of MFI which makes it easier to evaluate MFI performance and improvements it needs to undertake. This study had been published as Widiarto and Emrouznejad (2015).

VIII.1.5. Second Study: Loan Methodology and Not-For-Profit Microfinance Institution

The second study focuses on the relationship of loan methodology to overall, social, and financial efficiency of not-for-profit MFIs in six regions mentioned above. The observational period is 2000-2013 using a meta-frontier approach. Specifically, it seeks to provide empirical evidence as to whether a concept of "best" loan method exists. The finding showed that the concept of best loan methodology is also a relative concept; there are different loan methods and/or combination of methods that can boost efficiency in different regions. It is indeed observed that group loan is at the top loan ranking in many regions, as per early MFI literatures suggested, but in most regions it is not topping the rank single-handedly; in several regions and efficiency specifications, other loan methods hold the same position together with group loan.

Another important findings is that borrowings do not always lead to higher interest revenue, i.e. it mostly do not help financial efficiency due to higher interest costs it entails. In addition to that, the study also found that subsidy in the form of equity and cash donations do not always assists efficiency either, due to the disincentive for the MFIs to improve their performance. MFI regulation is found not to have significant correlation with efficiency; furthermore, it is found that unregulated MFIs to have higher efficiency in many regions. However, the third study provides interesting insight in regard to MFI regulation, which will be reiterated in Section VIII.2.

VIII.1.6. Third Study: Productivity of Not-For-Profit Microfinance Institution in Times of Crisis

In the final third study, productivity of not-for-profit MFIs in six different regions for the period 2003-2013 are assessed and indirectly compared to that of for-profit MFIs, using Circular Malmquist Index based on hyperbolic non-oriented DEA model. More specifically, it seeks to observe whether not-for-profit indeed have resilience to withstand the volatility from 2008 global financial crisis as suggested in the literatures.

It is indeed found that the increased integration toward traditional financial institutions through commercial lending had made not-for-profit MFIs and for-profit MFIs vulnerable to external shocks, akin to traditional financial institutions. This result commensurate with the result from second study, i.e. commercial borrowing does not contribute toward MFI efficiency. However, it is also found that 2008 financial crisis was not a root cause of volatility. In many cases, 2008 financial crisis only serves to aggravate the regional-scoped weaknesses. On the other hand, this study also provide empirical evidence that in many regions, the rapid growth of microfinance were not followed by prudent strategy, proper governance and sufficient regulation, all of which lead to the cause of almost all regional-based crises: over-ambitious MFI credit-led expansion and scaling up which lead to over-indebtedness problem.

VIII.2. Final Remark and Future Research Direction

(1) This research endorses frontier-based efficiency measurement as proficient method in microfinance performance measurement, due to its ability to overcome the focus on trade-off between microfinance objectives. More specifically, this study proposes DEA, especially hyperbolic non-oriented DEA model as an adept method for microfinance performance measurement. Moreover, this research also proposes the use of Circular Malmquist Index as per Portela and Thanassoulis (2008) to measure microfinance total factor productivity, due to its ability to handle unbalanced data and its circularity property.

On the other hand, it is acknowledged that hyperbolic non-oriented DEA model also not without limitation; due to its hyperbolic path to efficiency used herein, it postulates a *proportional* input-minimisation and output-maximisation simultaneously. This assumption is in reality restrictive since input-saving and output-expansion path required by an MFI does not necessarily have to be proportional. Therefore, the future study aims to develop a more flexible non-oriented model based on directional distance function to relax this proportionality property. The model to be developed aimed to enable efficiency to be measured by pursuing different proportion of input-saving and output-expansion based on MFI condition or objectives of MFI management/shareholder. Consequently, the future model will offer more realistic and flexibility in MFI performance analysis. The hyperbolic non-oriented DEA model used in this research acts as a foundation to the larger future study.

(2) This research concludes that in order for microfinance sector to grow stronger and healthily, a more standardised and structured global information database is greatly needed. The advanced database such as that in banking sector will assist all microfinance stakeholders to be able to monitor microfinance growth at the correct course. This research thus recommends MIX Market to work more proactively to approach policymakers and MFIs in building and improving its database. This research on the other hand recommends policymakers in each country to improve its microfinance regulations, especially in regard to standardised periodical report collection so that microfinance growth can be monitored and controlled.

(3) This research proposes that subsidy to be included in the future DEA model as input in DEA specification. More specifically, this subsidy variable should also incorporate subsidy in the form of soft or lower interest rates from external funders, as well as subsidy in the form of cash and equity donation. The former is currently very difficult to be included in the model due to data unavailability. Therefore, this research recommends MIX Market to collect and to present this data to the public as well so that more thorough model can be constructed. Alternatively, this research proposes further regional-based research in collaboration with MFIs and central banks or other

regulatory body using primary and regional-based secondary data in the future research so that comprehensive models can be constructed, especially in financial efficiency.

(4) Based on the third study on MFI productivity during external shocks, it is hereby recommended to the policymakers to pursue MFI regulation in their jurisdiction. Indeed, second study and literatures find that regulated MFIs do not necessarily showed higher efficiency. However, it is observed in the turbulent periods in most regions that the source of regional-scope microfinance crisis are insufficient regulation, uncontrolled MFIs competition in one area, lack of MFI internal governance and controlling, scaling up and over-aggressive expansion, all of which leads to excesses such as over-indebtedness (where borrowers borrow from many MFIs to cover one loan with another) and unethical collection. Should MFI regulation be pursued, these excesses may be able to be avoided, and it surely assists the sustainable and healthy growth of the sector.

However, MFI regulation does not always have to be pursued by transforming MFI into private companies. As the case in Indonesia, many rural banks and credit unions are regulated under the ministry of cooperatives. Regulating MFIs may assists in improving governmental monitoring of the sector, as well as building a more advanced and reliable database as periodical reporting will be collected. This in turn will assist in the advancement of the sector in the future.

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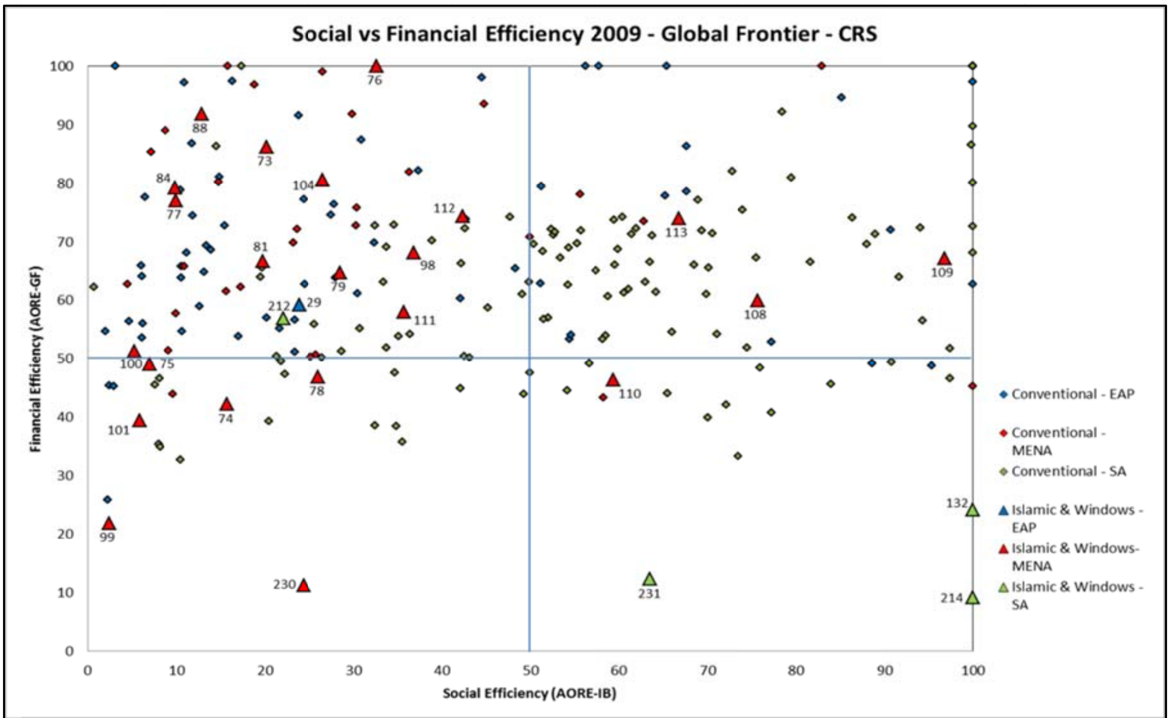
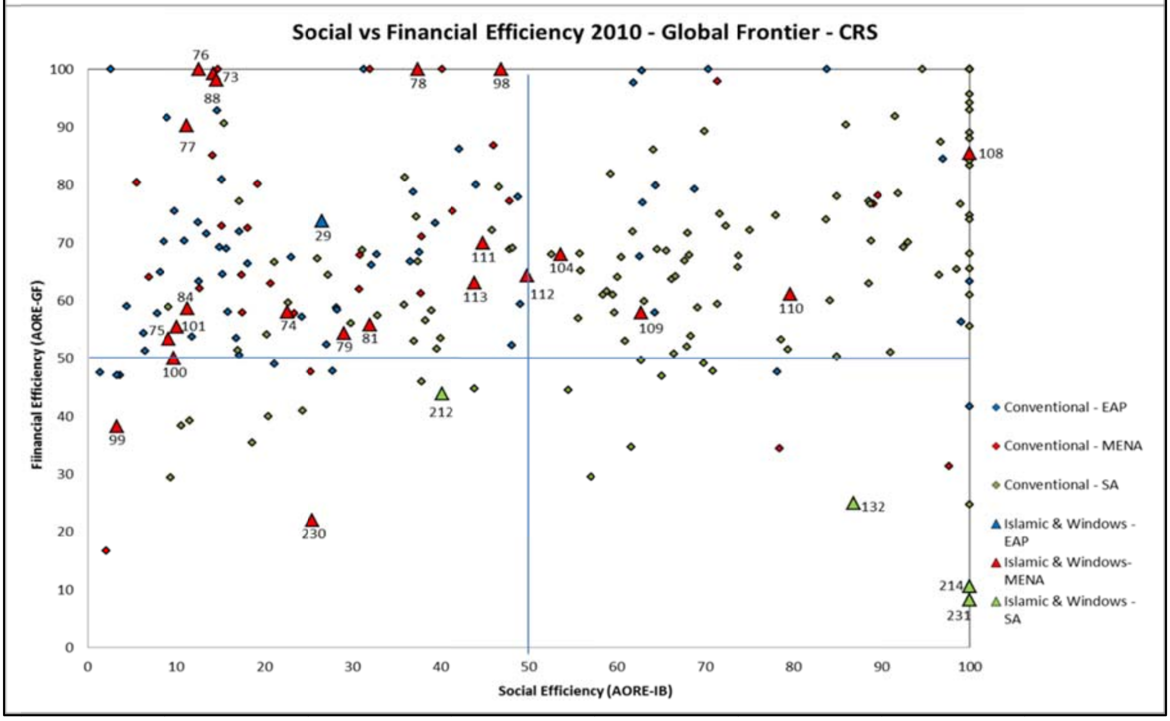
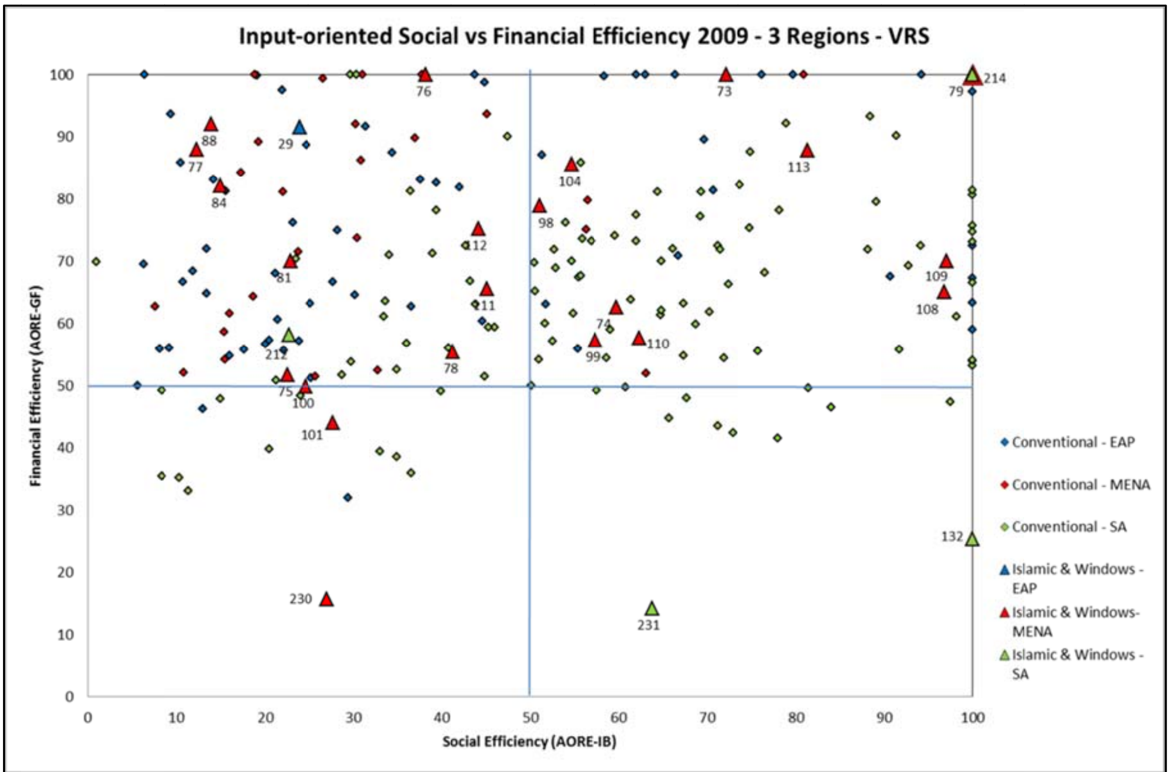
Appendices

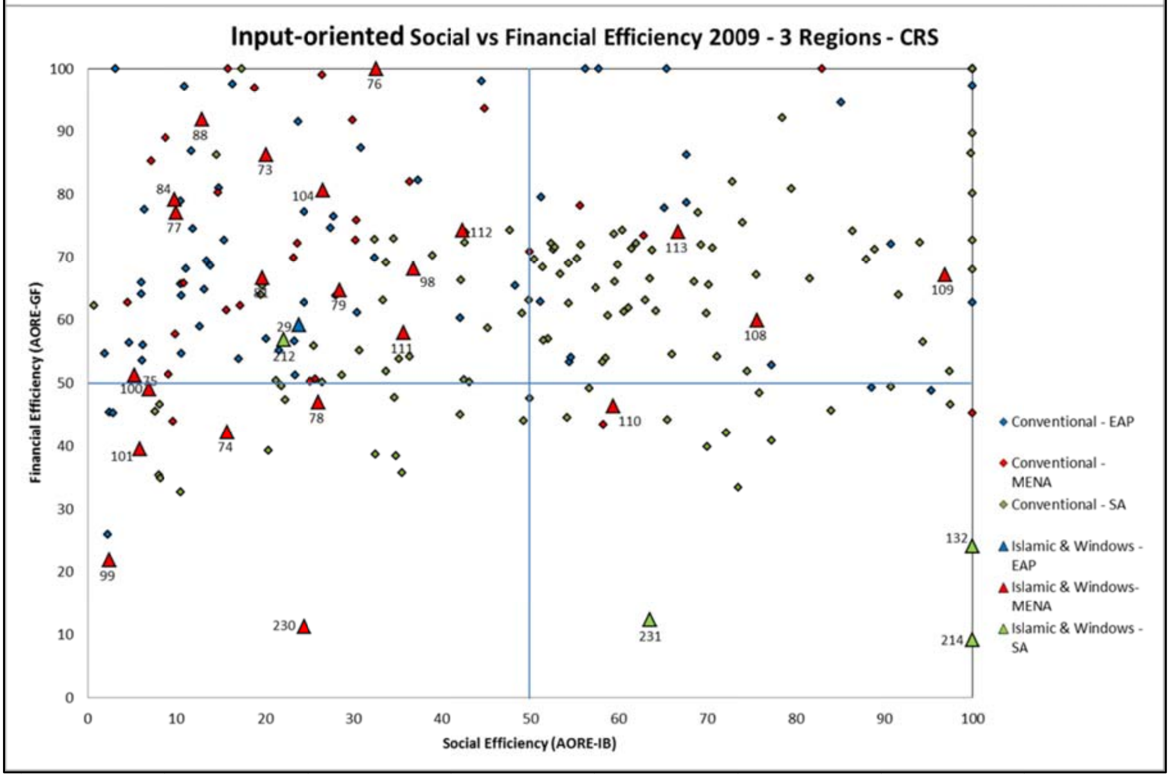
Appendix 1: SFE Matrix - CRS Global Frontier – Study I



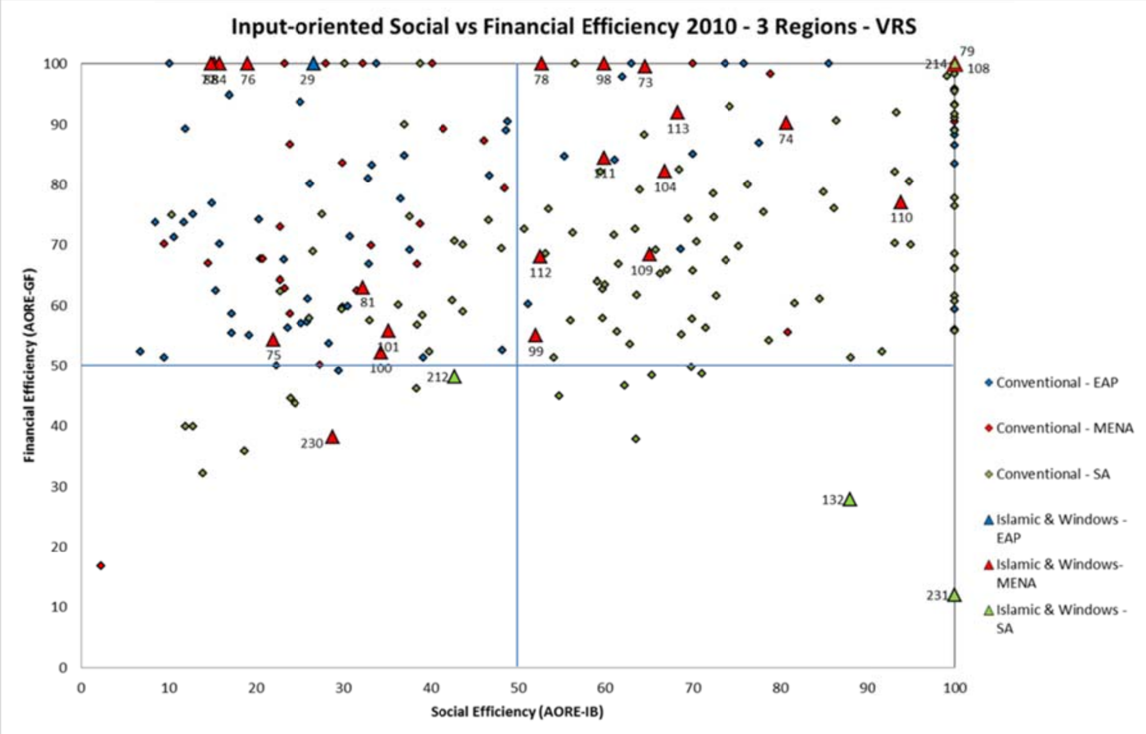


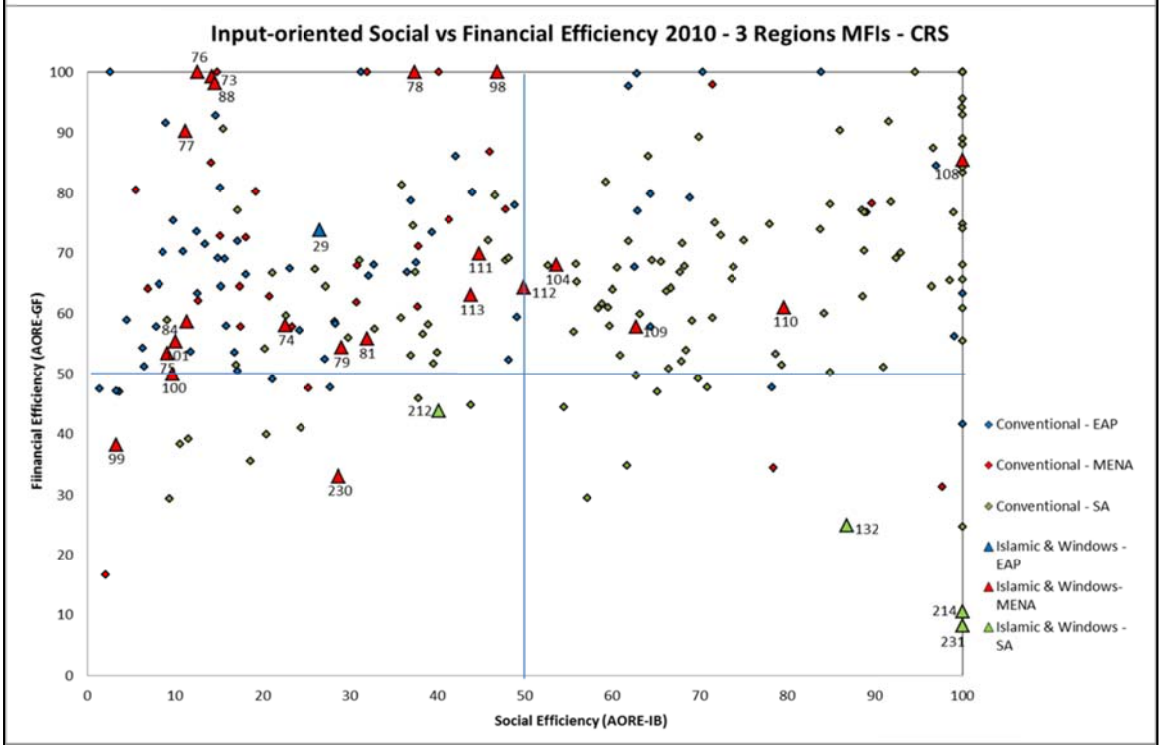
Appendix 2: Input-orientated SFE Matrix 2009 – VRS & CRS Global Frontiers – Study I



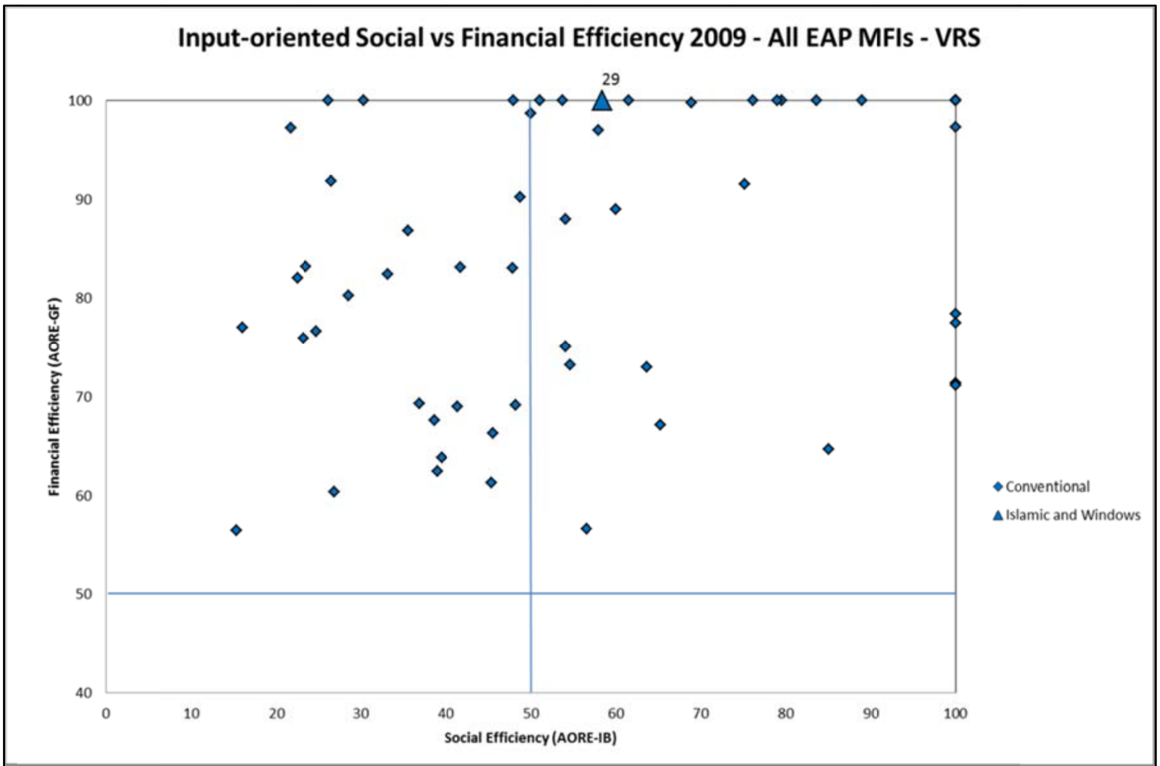


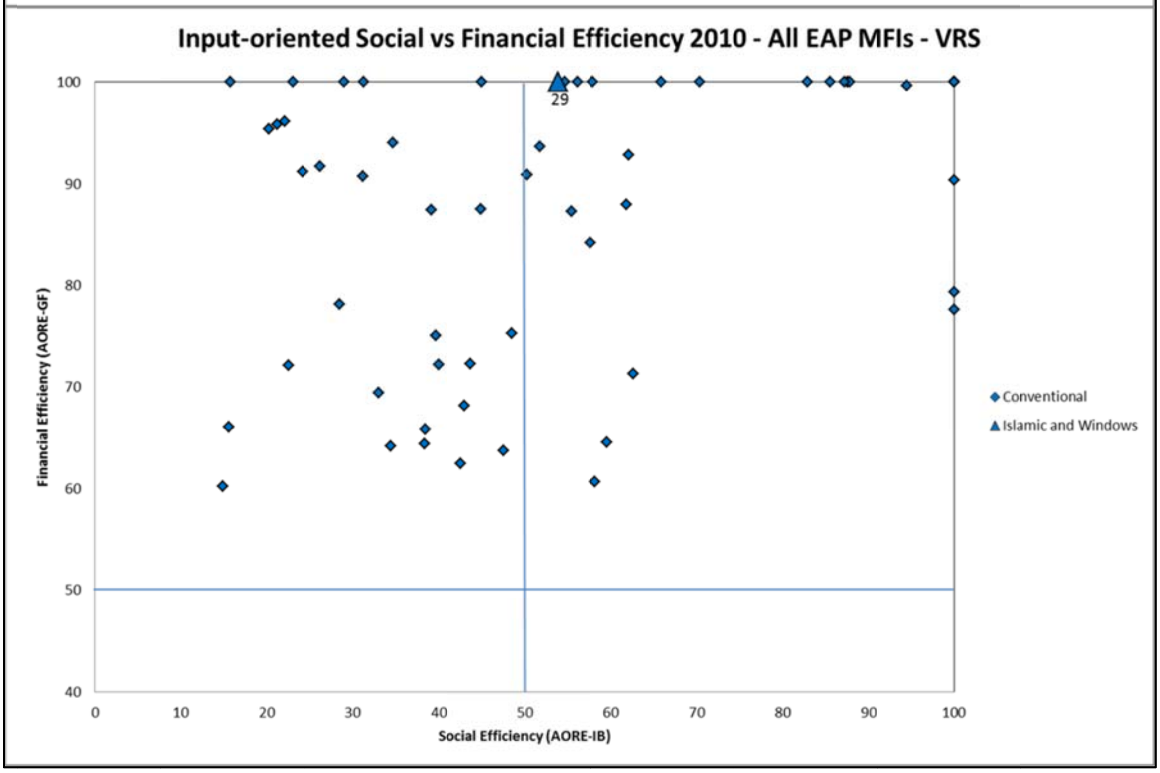
Appendix 3: Input-orientated SFE Matrix 2010 – VRS & CRS Global Frontiers- Study I



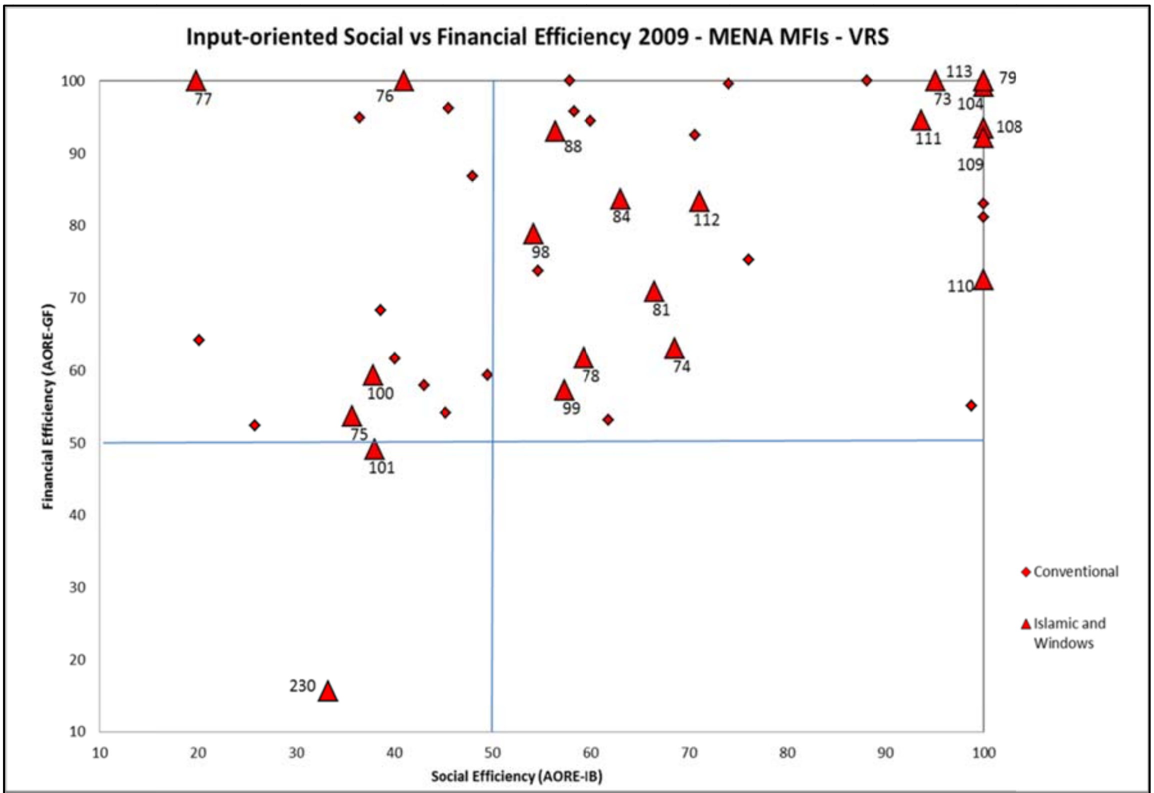


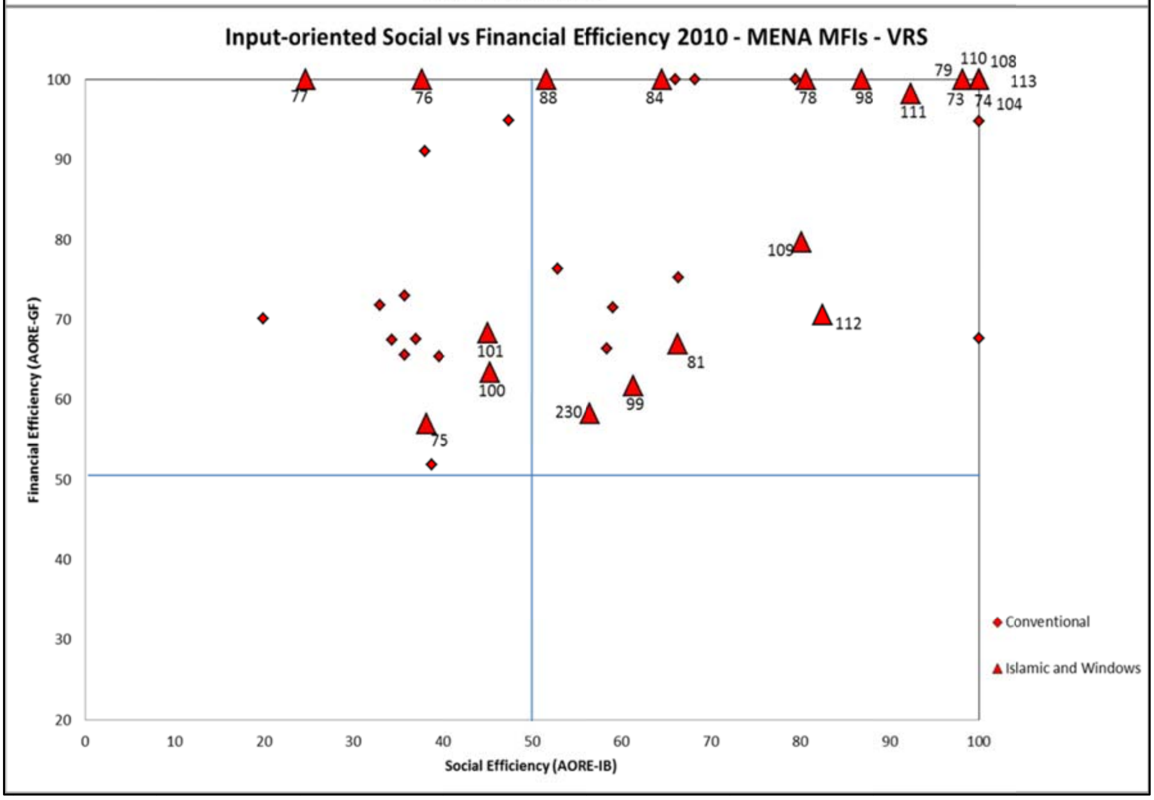
Appendix 4: Input-orientated 2009 & 2010 SFE Matrix VRS - EAP Frontier – Study I



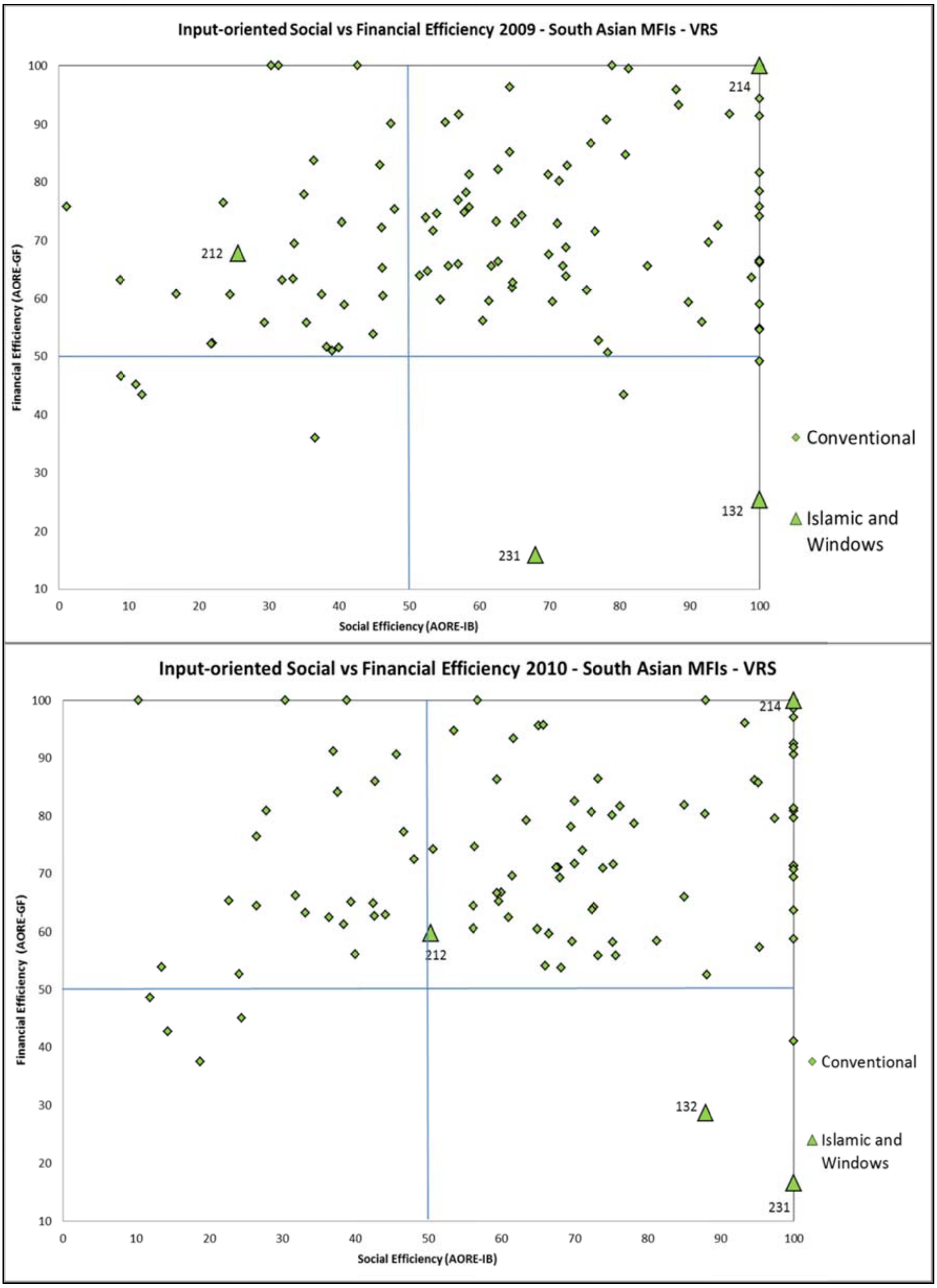


Appendix 5: Input-orientated 2009 & 2010 SFE Matrix VRS - MENA Frontier – Study I

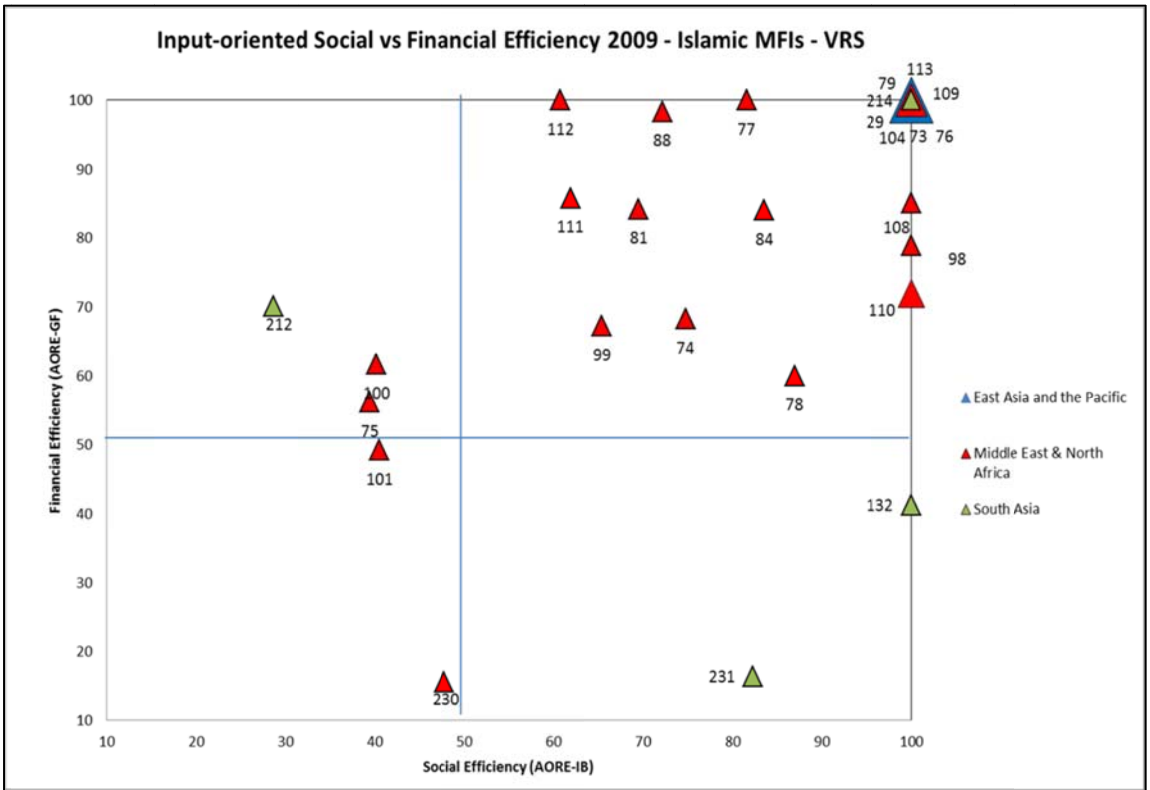


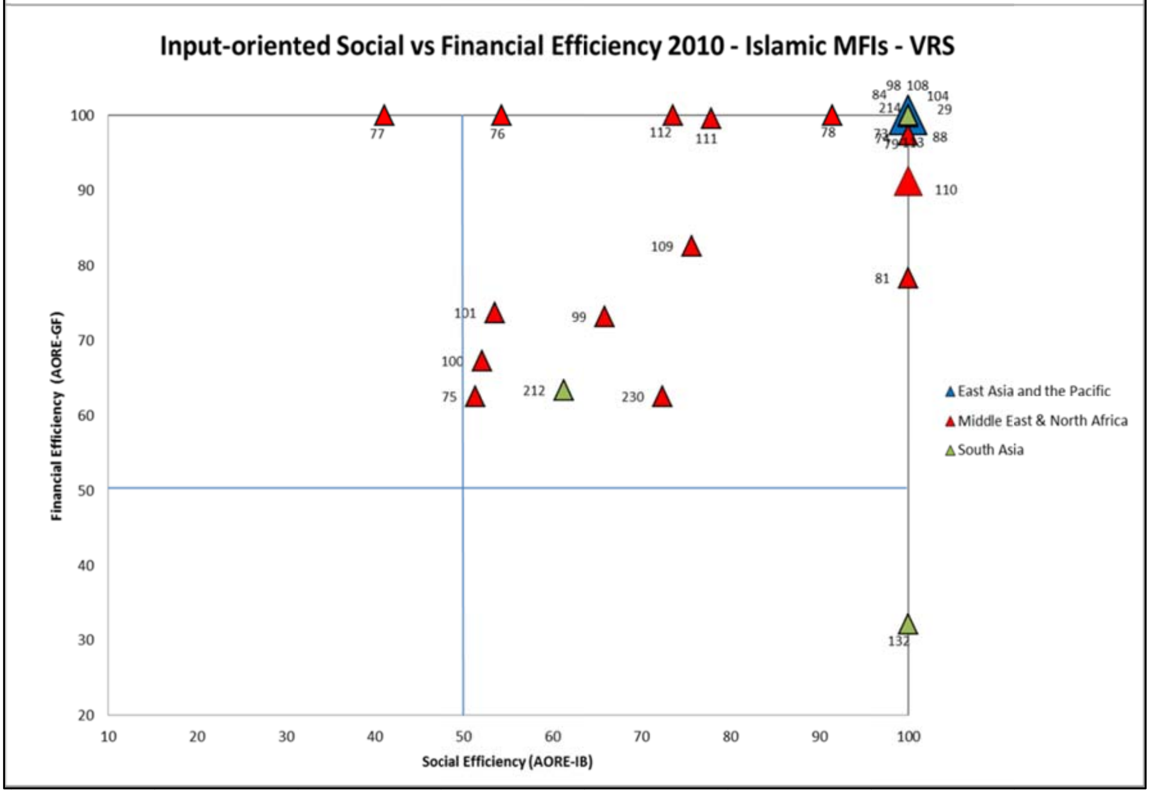


Appendix 6: Input-orientated 2009 & 2010 SFE Matrix VRS – SA Frontier – Study I



Appendix 7: Input-orientated 2009 & 2010 SFE Matrix VRS – Islamic Frontier – Study I





Appendix 8: Post DEA Analysis – MFI Efficiency VS MFI Scheme – Study I

Output-Oriented Model	Global Meta Frontier				MENA Regional Frontier				SA Regional Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *j* significant)
Overall Efficiency VRS	.598	11726.500	0.773		1.142	1430.000****	1.068	0.106	0.208	819.000	-0.456	
Overall Efficiency CRS	2.244****	12396.500***	1.498	0.070	0.152	1333.500	0.390		0.006	889.000	-0.080	
Financial Efficiency VRS	1.588	12177.500****	1.260	0.059	1.783	1472.500***	1.335	0.132	3.458***	1253.500**	1.860	0.122
Financial Efficiency CRS	7.483*	13538.000*	2.735	0.127	2.665****	1517.500**	1.632	0.162	16.626*	1671.000*	4.077	0.267
Social Efficiency VRS	7.297*	13504.500*	2.701	0.126	4.062**	1573.000**	2.016	0.200	1.291	691.000****	-1.136	-0.074
Social Efficiency CRS	6.873*	13433.000*	2.622	0.122	0.499	1380.500	0.706		2.045	635.000***	-1.430	-0.093
Scale Efficiency Overall	.398	11597.000	0.631		0.130	1329.000	0.360		1.186	699.500****	-1.089	-0.071
Scale Efficiency Financial	8.209*	13657.500*	2.865	0.133	2.820***	1524.500**	1.679	0.166	0.414	1025.000	0.643	
Scale Efficiency Social	2.257****	9631.000***	-1.502	-0.070	9.606*	817.500*	-3.099	-0.307	2.912***	583.000**	-1.707	-0.112

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

Input-Oriented Model	Global Meta Frontier				MENA Regional Frontier				SA Regional Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *j* significant)
Overall Efficiency VRS	0.113	10706.500	-0.337		0.289	1353.500	0.538		0.228	815.000	-0.477	
Financial Efficiency VRS	0.004	10955.500	-0.066		0.495	1379.500	0.703		3.528***	1257.000**	1.878	0.123
Social Efficiency VRS	0.288	11510.500	0.537		0.000	1273.000	-0.020		1.925	644.000***	-1.387	-0.091
Scale Efficiency Overall	12.589*	14285.000*	3.548	0.165	2.222****	1495.500***	1.491	0.148	3.654***	545.000**	-1.912	-0.125
Scale Efficiency Financial	35.176*	16484.000*	5.931	0.276	11.371*	1775.000*	3.372	0.334	5.622**	1350.000*	2.371	0.155
Scale Efficiency Social	14.009*	14466.500*	3.743	0.174	3.066***	1535.000**	1.751	0.173	5.191**	475.500**	-2.278	-0.149

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

Appendix 9: Post DEA Analysis – MFI Efficiency VS MFI Region – Study I

Output-Oriented Model	Global Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra		
	H-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	0.077	33457.500	0.235	
Overall Efficiency CRS	0.262	32385.000	-0.473	
Financial Efficiency VRS	12.016*	38232.000*	3.381	0.157
Financial Efficiency CRS	8.242**	37030.000*	2.588	0.120
Social Efficiency VRS	78.319*	21067.500*	-7.935	-0.369
Social Efficiency CRS	95.306*	19193.500*	-9.164	-0.426
Scale Efficiency Overall	1.665	32214.500	-0.585	
Scale Efficiency Financial	3.588	31369.000****	-1.142	-0.053
Scale Efficiency Social	62.025*	21129.000*	-7.889	-0.367

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

Input-Oriented Model	Global Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra		
	H-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	0.413	33971.500	0.575	
Financial Efficiency VRS	15.549*	39055.500*	3.924	0.183
Social Efficiency VRS	66.278*	22143.500*	-7.226	-0.336
Scale Efficiency Overall	5.016***	30066.500**	-2.001	-0.093
Scale Efficiency Financial	9.820*	30703.000***	-1.581	-0.074
Scale Efficiency Social	49.264*	22518.000*	-6.974	-0.324

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

Appendix 10: Post DEA Analysis – MFI Efficiency VS MFI Age– Study I

Output-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	0.973	24022.000	0.987		5.244**	726.000**	-2.290	-0.204	1.964	1478.000***	1.402	0.139	0.263	5836.000	-0.513		0.233	378.000	0.482	
Overall Efficiency CRS	0.165	23258.000	0.407		4.795**	734.000**	-2.190	-0.195	1.087	1429.500****	1.042	0.103	0.125	5912.000	-0.353		0.877	404.500	0.936	
Financial Efficiency VRS	0.691	23820.500	0.832		3.904**	767.500**	-1.976	-0.176	1.005	1423.500	1.002		2.475****	5317.000***	-1.573	-0.103	0.593	308.500	-0.770	
Financial Efficiency CRS	0.109	23158.000	0.331		1.740	863.000***	-1.319	-0.118	1.455	1454.500****	1.206	0.119	2.448****	5320.500***	-1.565	-0.102	0.065	337.500	-0.255	
Social Efficiency VRS	0.125	23187.000	0.353		2.590****	820.000**	-1.609	-0.143	2.675	1517.000**	1.635	0.162	0.005	6117.000	0.068		2.044	432.500***	1.430	0.195
Social Efficiency CRS	0.042	22991.500	0.205		0.300	978.000	-0.548		1.328	1446.500****	1.153	0.114	0.846	6533.000	0.920		3.656***	460.500**	1.912	0.260
Scale Efficiency Overall	3.454***	20261.000**	-1.858	-0.086	0.609	944.000	-0.780		0.008	1289.000	0.088		0.006	6047.500	-0.075		3.731***	460.00**	1.932	0.263
Scale Efficiency Financial	3.328***	20304.500**	-1.824	-0.085	0.058	1024.000	-0.241		0.289	1355.500	0.537		1.127	5566.000****	-1.062	-0.069	3.321***	455.500**	1.822	0.248
Scale Efficiency Social	4.342**	19961.000**	-2.084	-0.097	0.166	999.000	-0.408		1.589	1089.500****	-1.261	-0.125	2.269****	6819.000****	1.506	0.098	2.140****	435.000***	1.463	0.199

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

Input-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	0.266	23401.000	0.516		5.150**	729.000**	-2.269	-0.202	0.858	1409.500	0.926		0.001	6072.000	-0.025		0.000	353.000	0.019	
Financial Efficiency VRS	0.004	22637.500	-0.062		3.931**	766.500**	-1.983	-0.177	0.395	1368.500	0.629		2.835***	5263.000***	-1.684	-0.110	1.786	276.500***	-1.336	-0.182
Social Efficiency VRS	1.907	20893.000***	-1.381	-0.064	7.130**	662.00*	-2.670	-0.238	0.013	1293.000	0.115		0.782	6514.000	0.884		0.804	402.500	0.897	
Scale Efficiency Overall	0.265	22038.500	-0.515		0.010	1045.500	-0.098		0.767	1405.000	0.876		0.320	5808.500	-0.565		4.620**	472.500**	2.149	0.292
Scale Efficiency Financial	0.103	23145.000	0.321		0.669	1182.000	0.818		3.329***	1546.000**	1.825	0.181	1.184	5553.000****	-1.088	-0.071	2.162****	435.500***	1.470	0.200
Scale Efficiency Social	1.287	24222.000	1.134		1.612	1250.000	1.270		3.407***	1549.000**	1.846	0.183	0.213	6309.000	0.461		3.623***	460.000**	1.903	0.259

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

Appendix 11: Post DEA Analysis – MFI Efficiency VS MFI Profit Orientation – Study I

Output-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	10.213*	20521.500*	-3.196	-0.149	5.263**	1505.000**	-2.294	-0.204	10.702*	64.000*	0.019	-0.324	0.083	6479.000	-0.287		8.342*	17.000*	-2.888	-0.393
Overall Efficiency CRS	9.982*	20559.500*	-3.159	-0.147	11.316*	1279.000*	-3.364	-0.300	9.934*	67.500*	0.936	-0.312	0.197	6398.500	-0.443		8.871*	11.000*	-2.978	-0.405
Financial Efficiency VRS	0.003	24868.000	-0.052		0.773	1783.000	-0.879		13.097"	35.999*	-1.336	-0.358	2.938***	7496.000**	1.714	0.112	7.598*	17.000*	-2.757	-0.375
Financial Efficiency CRS	0.087	25348.500	0.294		3.356***	1588.000**	-1.832	-0.163	10.889*	56.000*	-0.255	-0.327	4.916**	7753.000**	2.217	0.145	6.640*	22.000*	-2.577	-0.351
Social Efficiency VRS	26.350*	17824.500*	-5.133	-0.239	34.465*	769.500*	-5.871	-0.523	5.897*	118.000*	0.897	-0.240	2.554****	5813.500***	-1.597	-0.104	5.286**	31.000**	-2.299	-0.313
Social Efficiency CRS	25.261*	17968.000*	-5.026	-0.234	46.382*	574.000*	-6.810	-0.607	5.151**	128.500*	1.912	-0.225	5.078**	5476.500**	-2.253	-0.147	5.055**	32.000**	-2.248	-0.306
Scale Efficiency Overall	0.724	23760.000	-0.851		17.101*	1124.000*	-4.135	-0.368	5.044**	131.000**	2.149	-0.222	0.993	7130.500	0.997		4.469**	37.000**	-2.114	-0.288
Scale Efficiency Financial	0.610	23856.500	-0.781		14.155*	1196.000*	-3.762	-0.335	1.360	370.000****	1.470	0.115	2.329****	7401.000***	1.526	0.100	1.049	69.000	-1.024	
Scale Efficiency Social	10.968*	20346.000*	-3.312	-0.154	5.750**	1472.000*	-2.398	-0.214	0.590	234.000	1.903		14.577*	4680.000*	-3.818	-0.250	4.339**	37.000**	-2.083	-0.283

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

Input-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	12.572*	20037.500*	-3.546	-0.165	5.462**	1496.500*	-2.337	-0.208	10.512*	66.000*	-3.242	-0.321	0.446	6287.000	-0.668		9.165*	13.000*	-3.027	-0.412
Financial Efficiency VRS	0.868	23648.000	-0.932		1.392	1722.500****	-1.180	-0.105	12.282*	43.000*	-3.505	-0.347	2.326****	7400.000***	1.525	0.100	5.718*	28.000*	-2.391	-0.325
Social Efficiency VRS	26.543*	17798.500*	-5.152	-0.240	29.002*	868.500*	-5.385	-0.480	3.830**	151.000**	-1.957	-0.194	6.462**	5334.500*	-2.542	-0.166	3.735**	42.000**	-1.933	-0.263
Scale Efficiency Overall	0.201	25561.000	0.448		13.256*	1224.500*	-3.641	-0.324	4.415**	141.000**	-2.101	-0.208	0.162	6828.500	0.402		3.0283***	48.000**	-1.740	-0.237
Scale Efficiency Financial	1.357	26556.000****	1.165	0.054	5.118**	1501.000**	-2.262	-0.202	0.220	255.000	-0.469		3.069***	7516.000**	1.752	0.115	3.929**	40.000**	-1.982	-0.270
Scale Efficiency Social	1.575	23199.000****	-1.255	-0.058	29.003*	864.000*	-5.385	-0.480	0.066	270.000	-0.256		0.885	6145.000	-0.941		1.264	66.000****	-1.124	-0.153

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

Appendix 12: Post DEA Analysis – MFI Efficiency VS MFI Loan Portfolio Scale– Study I

Output-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	27.514*	37583.000*	2.457	0.114	27.486*	2285.000****	-1.226	-0.109	12.805*	1845.500	0.912		9.503*	8807.000	0.250		9.045*	514.000	0.781	
Overall Efficiency CRS	7.763**	35408.500****	1.031	0.048	19.189*	2351.000	-0.900		5.011***	1642.000	-0.373		5.356***	9371.000****	1.270	0.083	4.430****	498.500	0.498	
Financial Efficiency VRS	43.336*	42684.00*	5.778	0.269	34.837*	2442.500	-0.485		8.908**	2056.500	2.206	0.218**	12.200*	10209.500*	2.788	0.182	13.139*	529.500	0.996	
Financial Efficiency CRS	24.638*	41352.000*	4.907	0.228	19.627*	2682.000	0.610		13.246*	2288.500	3.629	0.359*	12.579*	10594.500*	3.482	0.228	8.813*	524.500	0.910	
Social Efficiency VRS	16.363*	33405.500	-0.275		11.969*	2260.500***	-1.311	-0.117	15.774*	1399.000	-1.883	-0.186**	1.668	8616.500	-0.097		2.729	448.000	-0.325	
Social Efficiency CRS	13.466*	32722.000	-0.721		11.480*	2241.000***	-1.395	-0.124	21.432*	1229.000	-2.928	-0.290*	1.640	9058.000	0.702		2.683	464.500	-0.056	
Scale Efficiency Overall	63.686*	26818.000*	-4.574	-0.213	0.539	2372.000	-0.805		7.433**	1455.000	-1.537	-0.152***	0.472	8552.000	-0.214		2.921	538.000****	1.145	0.156
Scale Efficiency Financial	89.592*	30371.500**	-2.254	-0.105	1.756	2761.000	0.970		16.247*	2184.500	2.986	0.296*	21.418*	10165.000*	2.705	0.177	6.742**	528.500	0.974	
Scale Efficiency Social	18.323*	27623.000*	-4.046	-0.188	0.668	2438.000	-0.500		12.411*	1141.500	-3.470	-0.344*	1.314	8115.500	-1.003		0.324	443.000	-0.403	

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

Input-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	24.131*	35974.500***	1.405	0.065	28.364*	2204.000***	-1.604	-0.143	11.547*	1727.500	0.162		11.413*	8888.500	0.399		9.404*	507.000	0.662	
Financial Efficiency VRS	28.547*	39086.000*	3.430	0.160	37.183*	2302.500****	-1.128	-0.100	6.556**	1867.000	1.027		9.075*	9726.000**	1.912	0.125	14.264*	503.500	0.575	
Social Efficiency VRS	22.671*	30126.000*	-2.416	-0.112	24.895*	1611.000*	-4.275	-0.381	22.733*	1161.000*	-3.362	-0.333	5.456***	8674.500	0.008		1.746	417.000	-0.828	
Scale Efficiency Overall	45.876*	32197.000****	-1.064	-0.049	0.361	2575.500	0.126		1.012	1641.500	-0.376		7.809**	8869.500	0.362		1.014	527.500	0.971	
Scale Efficiency Financial	58.607*	39796.000*	3.892	0.181	3.888****	2983.000**	1.983	0.177	27.200*	2516.000*	5.037	0.499	45.7611*	12001.000*	6.027	0.394	3.014	538.500****	1.135	0.154
Scale Efficiency Social	10.545*	35234.500	0.918		17.580*	3129.000*	2.640	0.235	4.493****	1559.000	-0.885		31.540*	7444.500**	-2.218	-0.145	1.898	448.000	-0.322	

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

Appendix 13: Post DEA Analysis – MFI Efficiency VS MFI Target Customer – Study I

Output-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	36.033*	16719.500*	-5.477	-0.255	18.411*	1616.000*	-2.651	-0.236	7.095**	1089.000****	-1.152	-0.114	30.704*	2073.500*	-4.854	-0.317	8.987*	248.000*	-2.522	-0.343
Overall Efficiency CRS	41.591*	15328.500*	-6.495	-0.302	21.960*	1440.000*	-3.444	-0.307	6.581**	1081.500****	-1.179	-0.117	28.166*	2193.000*	-4.513	-0.295	8.283**	248.500*	-2.417	-0.329
Financial Efficiency VRS	4.887	23686.500	-0.285		13.084*	1964.500	-0.926		5.694**	1280.500	0.197		9.426*	3308.500**	-1.650	-0.108	4.432	387.500	-0.017	
Financial Efficiency CRS	3.195	22082.000***	-1.476	-0.069	13.404*	1840.000***	-1.515	-0.135	5.937**	1354.000	0.702		9.998*	3278.500**	-1.725	-0.113	4.504	402.500	0.239	
Social Efficiency VRS	210.066*	4265.000*	-14.719	-0.685	53.990*	779.500*	-6.609	-0.589	30.662*	520.000*	-5.060	-0.501	82.922*	499.000*	-8.877	-0.580	11.617*	200.500*	-3.231	-0.440
Social Efficiency CRS	195.771*	4970.500*	-14.184	-0.660	62.431*	745.000*	-6.751	-0.601	31.631*	501.000*	-5.172	-0.512	79.133*	557.500*	-8.696	-0.568	13.961*	173.500*	-3.667	-0.499
Scale Efficiency Overall	5.013	21923.500***	-1.595	-0.074	13.396*	1418.000*	-3.554	-0.317	1.338	1199.000	-0.367		4.376****	4641.00**	1.768	0.116	1.187	405.000	0.286	
Scale Efficiency Financial	17.446*	18730.500*	-3.965	-0.184	7.544**	1649.000*	-2.431	-0.217	0.669	1346.000	0.647		1.493	4115.000	0.418		4.045	423.500	0.596	
Scale Efficiency Social	22.374*	18228.000*	-4.339	-0.202	13.453*	1845.000***	-1.488	-0.133	0.474	1347.000	0.654		3.719	3249.000	-1.801		3.597	297.000***	-1.561	-0.212

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

Input-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	31.014*	17386.000*	-4.980	-0.232	17.804*	1614.500*	-2.658	-0.237	5.081***	1136.500	-0.816		24.641*	2292.500*	-4.288	-0.280	6.331**	274.000**	-2.056	-0.280
Financial Efficiency VRS	6.409***	23326.000	-0.553		12.673*	1940.000	-1.045		4.194****	1298.500	0.322		8.674*	3342.500***	-1.563	-0.102	2.296	401.000	0.214	
Social Efficiency VRS	118.403*	9510.000*	-10.821	-0.503	31.562*	1007.000*	-5.520	-0.492	8.534*	831.000*	-2.910	-0.288	68.522*	791.000*	-8.129	-0.531	5.207***	261.000**	-2.192	-0.298
Scale Efficiency Overall	18.709*	18677.500*	-4.007	-0.186	16.865*	1446.500*	-3.420	-0.305	7.837*	1005.000**	-1.709	-0.169	4.461****	3759.000	-0.495		5.613***	312.500***	-1.312	-0.179
Scale Efficiency Financial	12.565*	19948.500*	-3.061	-0.142	10.158*	1692.000**	-2.227	-0.198	4.024****	1245.000	-0.048		5.478***	3906.000	-0.118		5.140****	379.500	-0.153	
Scale Efficiency Social	85.545*	11586.500*	-9.271	-0.431	31.557*	1127.000*	-4.923	-0.439	44.709*	339.000*	-6.288	-0.623	7.066**	3401.500***	-1.411	-0.092	14.530*	168.000*	-3.761	-0.512

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

Appendix 14: Post DEA Analysis – MFI Efficiency VS MFI Regulatory Status – Study I

Output-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	10.009*	20226.500*	-3.164	-0.147	6.017**	1421.000*	-2.453	-0.219	5.383**	959.000*	-2.320	-0.230	3.214***	4520.000**	-1.793	-0.117	3.066***	268.000**	-1.751	-0.238
Overall Efficiency CRS	12.380*	19726.000*	-3.519	-0.164	11.300*	1230.000*	-3.361	-0.299	13.166*	757.500*	-3.629	-0.359	0.021	5265.500	-0.146		8.125*	201.500*	-2.850	-0.388
Financial Efficiency VRS	4.834**	21542.000**	-2.199	-0.102	0.802	1722.500	-0.896		6.0741**	930.500*	-2.465	-0.244	2.682****	4584.500**	-1.638	-0.107	5.280**	232.000*	-2.298	-0.313
Financial Efficiency CRS	8.593*	20532.000*	-2.931	-0.136	2.791***	1566.000*	-1.671	-0.149	11.970*	780.000*	-3.460	-0.343	0.876	4904.500	-0.936		7.820*	202.500*	-2.796	-0.381
Social Efficiency VRS	9.671*	20289.500*	-3.110	-0.145	31.103*	786.500*	-5.577	-0.497	5.242**	956.000**	-2.289	-0.227	0.414	5039.000	-0.644		0.674	317.000	-0.821	
Social Efficiency CRS	7.397*	20823.500*	-2.720	-0.127	42.223*	598.000*	-6.498	-0.579	7.3978*	890.500*	-2.720	-0.269	0.358	5605.500	0.599		1.827	286.000***	-1.352	-0.184
Scale Efficiency Overall	4.665**	21596.000**	-2.160	-0.100	17.725*	1062.000*	-4.210	-0.375	11.734*	788.000*	-3.425	-0.339	2.669***	6077.000**	1.634	0.107	4.833**	239.000**	-2.198	-0.299
Scale Efficiency Financial	9.556*	20312.000*	-3.091	-0.144	13.077*	1177.000*	-3.616	-0.322	2.216****	1074.000***	-1.489	-0.147	0.423	5629.000	0.650		0.567	320.500	-0.753	
Scale Efficiency Social	0.999	23192.000	-0.999		8.379*	1320.000*	-2.895	-0.258	4.394**	983.500**	-2.096	-0.208	0.041	5424.000	0.201		2.711***	269.000**	-1.646	-0.224

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

Input-Oriented Model	Global Meta Frontier				EAP Meta Frontier				MENA Meta Frontier				SA Meta Frontier				Islamic Meta Frontier			
	Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			Kruskal-Wallis	Jonckheere-Terpstra			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)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)	*H*-statistic	*J*-statistic	*z*-score	Effect size *r* (if *J* significant)
Overall Efficiency VRS	9.646*	20306.000*	-3.106	-0.144	6.258**	1411.500*	-2.502	-0.223	4.763**	979.000**	-2.182	-0.216	2.000	4691.500***	-1.414	-0.092	3.130***	267.000**	-1.769	-0.241
Financial Efficiency VRS	7.428*	20817.000*	-2.726	-0.127	1.503	1657.000****	-1.226	-0.109	4.832**	970.000**	-2.198	-0.218	3.310***	4501.500**	-1.819	-0.119	4.926**	236.500**	-2.219	-0.302
Social Efficiency VRS	6.509**	21058.000*	-2.551	-0.119	28.004*	844.000*	-5.292	-0.471	2.6112****	1056.000***	-1.616	-0.160	0.127	5170.000	-0.356		0.353	330.000	-0.594	
Scale Efficiency Overall	3.909**	21847.500**	-1.977	-0.092	13.768*	1162.000*	-3.711	-0.331	18.250*	662.000*	-4.272	-0.423	1.263	5844.500****	1.124	0.073	4.846**	238.500**	-2.201	-0.300
Scale Efficiency Financial	3.310***	22063.000**	-1.819	-0.085	4.010**	1500.000**	-2.002	-0.178	7.969*	875.000*	-2.823	-0.280	2.841***	6102.000**	1.686	0.110	3.931**	249.500**	-1.983	-0.270
Scale Efficiency Social	0.642	23465.000	-0.801		27.512*	849.000*	-5.245	-0.467	8.952*	850.000*	-2.992	-0.296	0.924	5771.000	0.961		2.654****	270.000**	-1.629	-0.222

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

Appendix 15: Tobit Regression Results – Other Efficiency Determinants – Study II

	Africa			EAP			EECA		
	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
Borrowings	0.0448392	-0.094027	0.165204	-1.17394	-0.42201	-1.876004	-0.12911	-0.05351	-0.08848
	[0.567]	[0.205]	[0.058]^{c}	[0.102]	[0.521]	[0.023]^{b}	[0.075]^{c}	[0.437]	[0.182]
Borrowings Squared	-0.0007115	0.0001086	-0.00122	-0.00534	-0.03106	0.019977	0.000193	0.000117	0.000124
	[0.086]^{c}	[0.786]	[0.01]^{b}	[0.787]	[0.104]	[0.365]	[0.061]^{c}	[0.237]	[0.194]
Total Donation	-0.4708121	-0.24819	-0.67227	-3.34596	-8.1728	2.968482	-0.21647	-0.21787	0.293583
	[0.055]^{c}	[0.303]	[0.018]^{b}	[0.228]	[0.003]^{b}	[0.365]	[0.281]	[0.142]	[0.041]^{b}
Total Donation Squared	0.003207	-0.002648	0.014208	0.610598	1.623611	-0.505221	0.004921	0.001202	-0.00153
	[0.644]	[0.7]	[0.078]^{c}	[0.34]	[0.012]^{b}	[0.508]	[0.217]	[0.297]	[0.067]^{c}
Cost Per Borrower	-0.0189549	-0.016773	-0.01658	-0.06989	0.038383	-0.315679	-0.01527	-0.00928	-0.02344
	[0.000]^{a}	[0.000]^{a}	[0.001]^{b}	[0.041]^{b}	[0.398]	[0.000]^{a}	[0.001]^{b}	[0.037]^{b}	[0.000]^{a}
Portfolio At Risk 30 days	0.3803682	0.6810172	0.964411	0.10971	0.523794	-1.012017	-0.12255	-0.09132	-0.21818
	[0.321]	[0.067]^{c}	[0.036]^{b}	[0.867]	[0.43]	[0.176]	[0.77]	[0.827]	[0.6]
Portfolio At Risk 90 days	-0.4349331	-0.705068	-0.98142	0.293765	-0.6258	1.694136	-0.25853	-0.2174	-0.2085
	[0.323]	[0.101]	[0.062]^{c}	[0.676]	[0.382]	[0.036]^{b}	[0.603]	[0.66]	[0.673]
Real Yield on Gross Portfolio	0.4745068	0.6064338	-0.00945	0.095315	0.121192	0.039928	-0.00521	0.135881	-0.22286
	[0.000]^{a}	[0.000]^{a}	[0.938]	[0.23]	[0.124]	[0.668]	[0.965]	[0.245]	[0.055]^{c}
Real Yield on Gross Portfolio squared	-0.0002473	-0.004563	0.003508	0.01211	0.010322	0.011249	-0.00184	-0.00109	-0.00224
	[0.938]	[0.149]	[0.343]	[0.000]^{a}	[0.000]^{a}	[0.001]^{a}	[0.714]	[0.827]	[0.647]
<u>Dummy variables for MFI legal status:</u>									
-Bank	-26.61057	-18.10555	-13.6406						
	[0.164]	[0.34]	[0.541]						
-Credit Union / Cooperative	-13.17767	-8.771015	-11.4692	5.178346	1.954736	14.4782	3.006635	4.47669	10.76028
	[0.002]^{b}	[0.033]^{b}	[0.018]^{b}	[0.242]	[0.658]	[0.006]^{b}	[0.577]	[0.395]	[0.041]^{b}
-NBFI	-12.56837	-3.322103	-25.0608	28.24536	4.797609	30.57929	8.70544	3.311	12.02921
	[0.118]	[0.667]	[0.006]^{b}	[0.001]^{b}	[0.533]	[0.002]^{b}	[0.072]^{c}	[0.487]	[0.012]^{b}
-Other MFI status				13.97569	17.52027	23.23151			
				[0.053]^{c}	[0.013]^{b}	[0.006]^{b}			
MFI Age Dummy	-3.302625	-0.393863	-20.8875	-3.6375	-2.30068	-8.695541	-5.06112	-1.28721	-1.89473
	[0.389]	[0.916]	[0.000]^{a}	[0.364]	[0.566]	[0.063]^{c}	[0.14]	[0.697]	[0.563]
Regulation Status Dummy	-6.77996	-7.69499	2.844929	4.321777	3.678894	3.650251	-2.11007	-0.52263	-8.33214
	[0.137]	[0.081]^{b}	[0.578]	[0.264]	[0.349]	[0.428]	[0.563]	[0.884]	[0.02]^{b}

	LAC			MENA			SA		
	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency	Overall Efficiency	Financial Efficiency	Social Efficiency
Borrowings	-0.000712	0.0391682	-0.03855	-0.04044	-0.083979	0.036596	-0.0140197	0.006478	-0.052091
	[0.959]	[0.009]^{b}	[0.009]^{b}	[0.1]^{c}	[0.002]^{b}	[0.292]	[0.612]	[0.82]	[0.107]
Borrowings Squared	0.0000082	-0.000016	0.00004	-0.0000195	0.0000496	-0.00012	0.000019	0.00001	0.0000538
	[0.365]	[0.083]^{c}	[0.000]^{a}	[0.488]	[0.072]^{c}	[0.005]^{b}	[0.454]	[0.694]	[0.08]^{c}
Total Donation	-0.079228	-0.091555	-0.06811	-0.0462912	-0.044295	-0.05746	-0.1628716	-0.19957	-0.101092
	[0.007]^{b}	[0.004]^{b}	[0.03]^{b}	[0.322]	[0.371]	[0.347]	[0.031]^{b}	[0.011]^{b}	[0.253]
Total Donation Squared	0.0000306	0.000038	0.000043	0.0000901	0.0002479	-0.00006	0.0007124	0.000789	0.00023
	[0.172]	[0.114]	[0.073]^{c}	[0.687]	[0.229]	[0.753]	[0.132]	[0.108]	[0.68]
Cost Per Borrower	-0.002293	0.0030474	-0.0224	-0.003972	-0.000368	-0.0002	-0.0373507	-0.00474	-0.055787
	[0.421]	[0.322]	[0.000]^{a}	[0.304]	[0.935]	[0.971]	[0.096]^{c}	[0.838]	[0.036]^{b}
Portfolio At Risk 30 days	0.8917505	0.5338755	0.630396	-0.582295	0.1218112	-0.55146	-0.1294314	-0.32294	-0.691345
	[0.000]^{a}	[0.038]^{b}	[0.015]^{b}	[0.428]	[0.884]	[0.597]	[0.843]	[0.632]	[0.37]
Portfolio At Risk 90 days	-1.153352	-0.674585	-0.97066	1.053741	0.128194	1.127187	-0.3445207	-0.17153	0.485709
	[0.000]^{a}	[0.024]^{b}	[0.001]^{b}	[0.297]	[0.909]	[0.429]	[0.632]	[0.817]	[0.567]
Real Yield on Gross Portfolio	0.1424257	0.3910788	-0.48311	0.4128396	0.1971221	-0.34769	0.0781177	0.372259	-0.345257
	[0.023]^{b}	[0.000]^{a}	[0.000]^{a}	[0.033]^{b}	[0.343]	[0.188]	[0.61]	[0.019]^{b}	[0.056]^{c}
Real Yield on Gross Portfolio squared	0.0048591	0.0000545	0.012951	0.0252384	0.016209	0.042561	0.0015755	-0.00604	0.008269
	[0.014]^{b}	[0.979]	[0.000]^{a}	[0.051]^{c}	[0.258]	[0.02]^{b}	[0.728]	[0.199]	[0.123]
<u>Dummy variables for MFI legal status:</u>									
-Bank	1.356813	-1.756702	14.84872						
	[0.869]	[0.843]	[0.093]^{c}						
-Credit Union / Cooperative	-10.30281	-1.377866	-21.3847				7.556955	10.30883	-10.31867
	[0.000]^{a}	[0.598]	[0.000]^{a}				[0.117]	[0.038]^{b}	[0.067]^{c}
-NBFI	-5.719869	-0.778033	-15.9858	-2.671305	8.362658	-7.64833	10.59912	6.289954	9.777064
	[0.242]	[0.883]	[0.002]^{b}	[0.583]	[0.138]	[0.258]	[0.144]	[0.393]	[0.241]
-Other MFI status				-28.735	-18.16864	-40.988	-4.021516	-8.50927	5.13937
				[0.057]^{c}	[0.299]	[0.055]^{c}	[0.649]	[0.354]	[0.623]
MFI Age Dummy	-2.424052	8.054532	-9.40808	-3.450071	-10.33132	-6.52096	-3.400689	-2.74189	-5.863684
	[0.377]	[0.006]^{b}	[0.001]^{b}	[0.453]	[0.044]^{b}	[0.31]	[0.285]	[0.403]	[0.118]
Regulation Status Dummy	10.09539	9.910742	4.670052	-9.261088	-6.962973	-12.5966	-4.235946	-6.38122	0.493291
	[0.011]^{b}	[0.02]^{b}	[0.267]	[0.014]^{b}	[0.102]	[0.016]^{b}	[0.128]	[0.027]^{b}	[0.88]

^{a} Significant at 99.99% confidence interval

^{b} Significant at 95% confidence interval

^{c} Significant at 90% confidence interval