MULTIDIMENSIONALITY OF PERFORMANCE DYNAMICS

IN

MICROFINANCE INSTITUTIONS: EVIDENCE FROM

EMERGING ECONOMIES

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A research thesis submitted in fulfilment of the requirement for the degree of Master of Research

Macquarie Graduate School of Management
Macquarie University
Sydney – Australia
October 2017

Declaration

This research project is submitted in fulfilment of the requirements of the degree of Master of Research, in Macquarie Graduate School of Management, Macquarie University. This represents the original work and contribution of the author.

I hereby certify that this has not been submitted for a higher degree to any other university or institution.

Signed:

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October 2017

Acknowledgements

I would like to express my deepest appreciation to all those who provided me the possibility to complete this research. A special gratitude I give to my supervisor Professor Masud Behnia for the useful comments, remarks and engagement through the learning process of this thesis.

Furthermore, I would like to express my most sincere gratitude to my brother, mentor and research advisor Dr. Arash Najmaei, without whom and helpful advice and supports this research could not be done.

Also, I would like to thank my special friend and mentor, Dr. Behroz Arabi for his always generous helps and supports.

As a result of this research, the following publications have been produced:

Conference Papers:

1. Najmaei, D., Behnia M. & Najmaei A. Triple Bottom Line of Microfinance Institution: An Empirical Analysis of Efficiency in BRIC Economies. Presented in the **AUSSRE 2017 International Research Conference on Theory and Practice in Social Science Fora,** Sydney Australia, October 2017**.**

2. Vogeley, J., Najmaei D., Impact of Digital Technologies on Social Productivity growth of Microfinance Institutions in Indonesia. Accepted to be presented at the **3rd International Conference on Transformation in Communication (ICoTiC) 2017,** Indonesia, November 2017.

Journal Papers:

1. Najmaei, D., Behnia M. & Najmaei A.: The Microfinance Movement: A Systematic Review of Performance Studies. Submitted to the **World Development**, October 2017.

2. Najmaei, D., Behnia M. & Najmaei A.: The Application of Data Envelopment Analysis in Microfinance: How It Came and Where It Is Expected to Go? Submitted to the **Review of Development Economics**, October 2017.

3. Najmaei, D., Behnia M. & Najmaei A. A Multidimensional Analysis of The Performance Dynamics of Microfinance Institution: Evidence from Emerging Economies. Submitted to the **Economic Modeling**, October 2017.

Table of contents

ABSTRACT

Microfinance Institutions (MFIs) have been proven to be an effective organizational channel to alleviate poverty and create social value in many countries. The cost-effective provision of financial services to underprivileged communities has caused the industry to grow over decades. However, the low performance of MFIs has hindered the industry from reaching its maximum. Moreover, studying the multidimensionality of MFIs is a recent topic, with limited attention to the environmental bottom line and dynamic evaluation. Therefore, this study aims to address these gaps by applying the Malmquist Index (MI), with further investigation of the source of performance dynamics. We apply an unbalance panel of 53 MFIs across three major emerging countries for the years 2009-2015 (214 observations). An approach for dealing with unbalanced data is also developed and used. The results suggest that the financial and environmental performance have slightly improved due to the progress in technical efficiency. Nonetheless, the dynamics of overall performance, represented by the change in overall productivity, has deteriorated in line with social performance deterioration. Unlike financial and environmental performance, technological advances have a positive impact on social and overall performance.

List of Abbreviations

Microfinance Institution	MFI
Data Envelopment Analysis	DEA
Brazil, Russia, India and China	BRIC
Stochastic Frontier Approach	SFA
Partial Least Square	PLS
Technical Efficiency	TE
Pure Technical Efficiency	PTE
Scale Efficiency	SE
Performance Index	PI
Malmquist Index	MI
Malmquist Productivity Index	MPI
Technological Change	TC
Technical Efficiency Change	TEC
Environmental Performance	EP
Financial Performance	FP
Social Performance	SP
Return On Asset	ROA
Operational Self Sufficiency	OSS
Constant Return to Scale	CRS
Variable Return to Scale	VRS

List of Tables

List of Figures

1. CHAPTER ONE - INTRODUCTION

Microfinance Institutions (MFIs) are non-lucrative organisations whose objective is combating poverty by provision of permanent access to financial services for low-income people (Jansson, von Stauffenberg, Kenyon, & Barluenga-Badiola, 2003). The use today of the expression microfinance dates back to the 1970s, when the microfinance pioneer Mohammad Yunus shaped the modern industry of microfinance and enacted the idea in the Grameen Bank of Bangladesh. Ever since their inception, MFIs have shown to contribute to the economic development and growth of countries, from micro and macro perspectives (Mia & Chandran, 2016).

Modern microfinance stimulates the institutional power of the financial sector, through introducing a cost-effective system of money lending from a broad range of financial services such as credit, saving, insurance, and money transfer (Morduch, 1999a). Therefore, microfinance has been replicated in many developing countries (Helms, 2006). MFIs are on a path of continual growth and now provide services for more than 150 million people worldwide through more than 10,000 institutions (Microworld, 2016).

Despite the significant contribution and growth of microfinance, over 500 million people remain excluded from financial services (Microworld, 2016). This situation is possibly rooted in low performance and inefficiency of MFIs that hinders their social outreach and financial sustainability (Mersland & Strøm, 2009). Therefore, studying the performance of MFIs contributes to the efficient use of resources and to improving their outreach and sustainability, which is vital not only for MFIs but also for donors and international supporters.

The literature in this context is booming. According to Web of Science (www.webofscience.com), the number of microfinance studies exceeds two thousand, while more than a fourth focused on its performance. Hence, the time is ripe for an integrative review to take the stock of the literature. Therefore, we narrow the review of the literature to the key

studies that assessed the performance of MFI. Then, grounded upon the most recent gaps, this study contributes to the body of knowledge through an empirical study.

The gaps addressed by this study's empirical analysis are as follow: First and the foremost, we found insufficiency of dynamic analysis in performance evaluations. To the best of the authors' knowledge, the only studies that assessed performance dynamics through measuring productivity change are Bassem (2014), Gebremichael and Rani (2012), Mia and Chandran (2016) and Wijesiri and Meoli (2015). We benefit from the novelty of these studies and then advance the dynamic evaluation through filling their gaps. More precisely, evaluating triple bottom line of MFIs with considering environmental dimension of performance remained unattended in dynamic studies. However, some non-dynamic studies quantified and qualified MFIs environmental performance, such as Allet (2012, 2014), Allet and Hudon (2015) and Forcella and Hudon (2016). Similar with social performance, the assessment of environmental performance depends on both current and future social and financial performance (Copestake, 2007). Moreover, the environmental-related outputs are time-lagged as they are hidden in policies and client's activities, therefore the long-run evaluation is more proper (Allet, 2012). Therefore, dynamic evaluation of environmental performance is of a great value for better policy making.

Secondly, the quality of outreach has been underemphasised in the assessment of social performance. More precisely, the majority of MFI studies see the depth and breadth of outreach as the only aspects of social performance (Bassem, 2008; Begoña, Carlos, & Cecilio, 2007). However, MFIs' social performance is evaluated through three aspects of depth, breadth and quality of outreach (Zeller, Lapenu, & Greeley, 2003). Therefore, this study considers all three aspects of social performance by proposing a new variable that assesses the implementation of MFIs' social goals.

The third gap in prior studies is ignoring dynamic evaluation when panel data is unbalanced. According to Kerstens and Woestyne (2014), this is mainly due to software inability. Investigating the common sources of data in microfinance, we found that unbalanced panel is prevalent in microfinance database, which necessitates providing solution for dealing with this type of panel. This study employs MAXDEA by Gang and Hua (2009) as it is able to cope with unbalanced panel by considering unavailable data as missing. To improve the reliability of method, we also apply two tests, outlier detection and Missing Completely At Random (MCAR), on the original data.

We measure changes in total factor productivity as a proxy of performance by Malmquist Index (MI) and further break down the index into technological change, scale efficiency change and pure technical efficiency change to capture the source of growth. The advantages of MI are numerous. First, MI requires only inputs and outputs quantities without requiring price information. Moreover, it allows analysis of multiple inputs and outputs. Lack of requirement of assumptions on functional formulations of production processes is another favoured feature of MI that increase the computational ease of this method. Last but not least, MI can be further decomposed into several components that improve the applicability and usability (Oh, Oh, & Lee, 2017)

We select three major emerging countries, Brazil, India and China as the sample of emerging economies. Due to the economic similarities among these three countries, we estimate MFIs performance based on one frontier for all MFIs, therefore the separate investigation of each countries is out of this study's scope. The rationale behind this selection is threefold. First, the large domestic market as well as lower risk of investment, compared to smaller developing economies (Armijo, 2007) increase the chance of growth, and productivity growth of microfinance in these economies. Secondly, the swift economic growth of emerging economies, at least partially, lies on the microfinance growth, since microfinance leads to

economic growth and development through leveraging private capital and poverty reduction (Matthäus-Maier & Von Pischke, 2006) and also through improvement of entrepreneurship (Acs, 2006). Last but not least, the large population of these countries in addition to generous inflow of international donors (Kumar, Renganathan, VijayaBanu, Anand, & Prakash, 2016) can provide the potential for overuse and inefficient application of resources, which calls for more attention of efficiency scholars.

Accordingly, the empirical study seeks to address the following questions:

1) How has the overall performance of MFI in major emerging economies changed?

2) What is the level of growth in each dimensions of performance in terms of social, financial and environmental performance?

3) What is the main driver of performance change in terms of change in the scale of production, technical efficiency and technological advance?

The rest of this study is organised as follow. In the next chapter, the review of the literature is stated. Then, chapter three shapes methodology and data along with explanation on the selected indicators. Chapter four provides the result of the empirical analysis in conjunction with the discussion. The fifth chapter concludes and states the implications and limitations of this research.

2. CHAPTER TWO - LITERATURE REVIEW

This chapter reviews two samples of literature to point to the under- and over-emphasised issues regarding performance of MFIs, in terms of performance dimension, data nature, data size and access, performance-related domains, method, and measurement. Firstly, this study systematically reviews 53 key journal articles that in some way address the performance of MFIs. As a requirement of the Systematic Review (SR) process, the articles are selected only from A and A* journals, ranked by the Australian Business Dean Council (ABDC, 2014). Then, due to the importance and dominance of the method of DEA in microfinance studies, the second strand of the review delves into 24 publications that evaluate the efficiency of MFIs using DEA. The second strand of the review also briefly reviews additional 23 non-DEA and non-MFI studies that can contribute in addressing the review's objectives.

It should be pointed out that there are some studies that have been reviewed within both strands. However, as each strand of the review follows different objectives, this overlap will not cause any recurrence in the analysis.

The findings from Chapter Two revealed the most contributing direction for future empirical research. This chapter continues, next, by explaining the framework for each review. Then, separate analysis is carried out for each of the studies within each strand. The chapter ends with an integrative conclusion derived from the findings of the two reviews.

2.1. Collecting the literature

2.1.2. PRISMA: Systematic Review protocol

To conduct the Systematic Review, we adopt the framework based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) proposed by Moher, Liberati, Tetzlaff, & Altman (2009). This is based on the identification and screening of potentially eligible studies, which determines the final number of studies included for analysis. The

methodological protocol of this review is presented in Figure 1. To start, the database "Web of Science" core collection is selected as the quality scientific reference, since it is multidisciplinary and, in the social sciences, it is one of the most comprehensive databases chosen by peer-reviewed journals due to being based on measurable criteria (Falagas, Pitsouni, Malietzis, & Pappas, 2008).

The initial stage of our review describes the selected key words to extract the most relevant literature. To have the exploration at its maximum amplitude and have an inductive approach without any prior expectation or fixed group, the selection criteria needs to cover a range from holistic to specific (Zhang & Wildemuth, 2009). Therefore, we first select "microfinance" as the general topic in the initial stage. The selection of next-stage keywords is based on a suggestion from an expert in the field of Microfinance. The keywords are "microfinance" OR "micro bank" OR "rural finance".

In contrast to microfinance, the keywords related to "performance" need more discussion, as the concept of performance is not as straightforward due to its multi-dimensional nature (Gutiérrez-Nietoa, Serrano-Cincaa, & Molinero, 2007). More importantly, MFI performance is defined based on the dual financial and social objectives (Widiarto & Emrouznejad, 2015). Therefore, before selecting performance-related keywords, we provide a brief specification of performance.

Keywords: microfinance institution or micro-banker or financial inclusion

Keywords: performance or productivity or profitability or sustainability or efficiency or outreach

English-written journal articles

A and A* journals from ABDC

Alignment with the objective: Excluding Loan performance, Repayment performance, Credit performance

Adding 1 highly cited (Seminal) paper (53 articles)

Searching the general topic

1967 articles identified

Initial search on specific topic

582 articles identified

Refinement on language and document type

421 citations identified

Journal quality assessment

163 articles identified

Content relevance Abstract, introduction, and conclusion screen

Papers for synthesis (52 articles)

Identification

Screening

Eligibility

Included

Figure 1 the protocol of systematic review proposed by Moher, Liberati, Tetzlaff, and Altman (2009)

The term performance is often confused with productivity, efficiency and profitability (Sink & Tuttle, 1989; Tangen, 2005). We summarise the most common interchangeable terms with performance in Table 1. In many microfinance studies, profitability is also applied interchangeably with financial sustainability (Biener & Eling, 2011). On the other hand, social performance is also known as "outreach" (Ledgerwood, 1998). Therefore, to cover all relevant studies that have researched financial and social performance of MFI, we select the following keywords: "performance" OR "productivity" OR "profitability" OR "efficiency" OR "sustainability OR outreach" which results in finding 582 citations.

Table 1 Interchangeable terms with performance

Term	Definition
Productivity	The relation of output (product) to input (resources) that can be measured by labour, land or another factor productivity. The best measure of productivity is "total factor productivity" (Coelli, Rao, O'Donnell, & Battese, 2005).
Profitability	The ratio between revenue and cost, which mainly addresses shareholders' issues (Bottazzi, Secchi, & Tamagni, 2008).
Efficiency	In production theory, refers to the utilization of inputs into outputs. The distinction of productivity and efficiency is related to the scales of economies, where the firm can be technically efficient at a non-optimal scale while is not productive. Moreover, the change in productivity can be due to change in efficiency or because of technical change (Coelli et al., 2005).
Financial sustainability	For MFIs, refers to the direct pay for the full cost of providing services by service users. In microfinance, financial sustainability and profitability are considered the same (Yaron, 1994).

Source: Authors' summary from Bottazzi et al. (2008), Coelli et al. (2005), Yaron (1994)

The second stage of PRISMA, named "Screen", refines the result of the last stage in terms of language and manuscript type, which can be done by the filtering facilities of the Web of Science (WoS) database. The filtering process is carried out by WoS, which results in 421 English-written journal articles.

In the third stage, "eligibility", the articles should meet a high standard for researchers (Moher et al., 2015). The frequency of citation has been the predominate measurement of journal quality (Garfield, 2006). Therefore, in this effort we limit the search only to the journals that are ranked as A and A* by the Australian Business Dean Council (ABDC) journal quality list, based on citation metrics, quality of peer-review processes, sustained reputation, and international standing of the editorial board (ABDC, 2014). After this stage, 163 articles remained.

According to Moher et al. (2015), the final stage of a systematic review is checking the concept relevance. Therefore, by applying several inclusion and exclusion criteria, we determine the final list of articles. The main inclusion criterion is that the article's objective should be either, evaluating MFIs' performance, or being relevant to MFIs' performance.

On the other hand, we exclude articles that measured non-institutional performance, such as repayment, credit or the whole industry's performance, as the objective of this review focuses on institutional performance.

Consequently, we extract 52 articles that are published in 22 A and A* journals. In the final stage, we follow the expert checking process suggested by Webster and Watson (2002), and add 1 highly cited source which can be called a seminal work in the field. This process leads us to the final set for review, composed of 53 papers from 23 journals, presented in Table 2. The frequency of journals and areas is further stated in Table 17, presented in Appendix A.

Table 2 List of extracted articles and journals from Moher's Protocol

	Author and year	Title	Journal
1	Yaron (1994) *	What Makes Rural Finance Institutions Successful	The World Bank Research Observer
2	Mosley & Hulme (1998)	Microenterprise finance: is there a conflict between growth and poverty alleviation?	World Development
3	Morduch (1999b)	The role of subsidies in microfinance: evidence from the Grameen Bank	Journal of Development Economics
4	Morduch (1999a)	The microfinance promise	Journal of Economic Literature
5	Conning (1999)	Outreach, sustainability and leverage in monitored and peer-monitored lending	Journal of Development Economics
6	Navajas, Schreiner, Meyer, Gonzalez-Vega, & Rodriguez-Meza (2000)	Microcredit and the Poorest of the Poor: Theory and Evidence from Bolivia	World Development
7	Morduch (2000)	The microfinance schism	World Development
8	Park & Ren (2001)	Microfinance with Chinese characteristics	World Development

9	MkNelly & Kevane (2002)	Improving design and performance of group lending: Suggestions from Burkina Faso	World Development
10	Hartarska (2005)	Governance and performance of microfinance institutions in central and eastern Europe and the newly independent states	World Development
11	Coleman (2006)	Microfinance in Northeast Thailand: Who benefits and how much?	World Development
12	Cull & Morduch (2007)	Financial performance and outreach: A global analysis of leading micro-banks	The Economic Journal
13	Hartarska & Nadolnyak (2007)	Do regulated microfinance institutions achieve better sustainability and outreach? Cross-country evidence	Applied Economics
14	Copestake (2007)	Mainstreaming microfinance: Social performance management or mission drift?	World Development
15	Gutiérrez-Nietoa et al. (2007)	Microfinance institutions and efficiency	Omega-International Journal of Management Science
16	Gutiérrez-Nieto, Serrano-Cinca, & Molinero (2009)	Social efficiency in microfinance institutions	Journal of The Operational Research Society
17	Mersland & Strom (2009)	Performance and governance in microfinance institutions	Journal of Banking & Finance

18	Mersland & Strøm (2010)	Microfinance mission drift?	World Development
19	Mersland, Randoy, & Strom (2011)	The impact of international influence on micro-banks' performance: A global survey	International Business Review
20	Cull, Demirguc-Kunt, and Morduch (2011)	Does Regulatory Supervision Curtail Microfinance Profitability and Outreach?	World Development
21	Hudon & Traca (2011)	On the Efficiency Effects of Subsidies in Microfinance: An Empirical Inquiry	World Development
22	Hermes, Lensink, & Meesters (2011)	Outreach and Efficiency of Microfinance Institutions	World Development
23	Ahlin, Lin, & Maio (2011)	Where does microfinance flourish? Microfinance institution performance in macroeconomic context	Journal of Development Economics
24	Galema, Lensink, & Mersland (2012)	Do Powerful CEOs Determine Microfinance Performance?	Journal of Management Studies
25	Servin, Lensink, & van den Berg (2012)	Ownership and technical efficiency of microfinance institutions: Empirical evidence from Latin America	Journal of Banking & Finance

26	Bogan (2012)	Capital structure and sustainability: an empirical study of microfinance institutions	Review of Economics and Statistics
27	Quayes (2012)	Depth of outreach and financial sustainability of microfinance institutions	Applied Economics
28	Kebede & Berhanu (2012)	How efficient are the Ethiopian microfinance institutions in extending financial services to the poor? A comparison with the commercial banks	Journal of African Economics
29	Hartarska & Mersland (2012)	Which Governance Mechanisms Promote Efficiency in Reaching Poor Clients? Evidence from Rated Microfinance Institutions	European Financial Management
30	Vanroose & D'Espallier (2013)	Do microfinance institutions accomplish their mission? Evidence from the relationship between traditional financial sector development and microfinance institutions' outreach and performance	Applied Economics
31	Mersland, D'Espallier, & Supphellen (2013)	The Effects of Religion on Development Efforts: Evidence from the Microfinance Industry and a Research Agenda	World Development
32	Louis, Seret, & Baesens (2013)	Financial Efficiency and Social Impact of Microfinance Institutions Using Self-Organizing Maps	World Development
33	Hartarska, Shen, & Mersland (2013)	Scale economies and input price elasticity in microfinance institutions	Journal of Banking & Finance

34	Allet (2014)	Why Do Microfinance Institutions Go Green? An Exploratory Study	Journal of Banking & Finance
35	Hartarska, Nadolnyak, & Mersland (2014)	Are Women Better Bankers to the Poor? Evidence from Rural Microfinance Institutions	American Journal of Agricultural Economics
36	Strom, D'Espallier, & Mersland (2014)	Female leadership, performance, and governance in microfinance institutions	Journal of Banking & Finance
37	Bassem (2014)	Total factor productivity change of MENA microfinance institutions: A Malmquist productivity index approach	Economic Modelling
38	Cull, Demirguc-Kunt, & Morduch (2014)	Banks and micro-banks	Journal of Financial Services Research
39	Barry & Tacneng (2014)	The Impact of Governance and Institutional Quality on MFI Outreach and Financial Performance in Sub-Saharan Africa	World Development
40	Piot-Lepetit & Nzongang (2014)	Financial sustainability and poverty outreach within a network of village banks in Cameroon: A multi-DEA approach	European Journal of Operational Research

41	Quayes (2015)	Outreach and performance of microfinance institutions: a panel analysis	Applied Economics
42	Casselman, Sama, & Stefanidis (2015)	Differential Social Performance of Religiously-Affiliated Microfinance Institutions (MFIs) in Base of Pyramid (BoP) Markets	Journal of Business Ethics
43	Allet & Hudon (2015)	Green Microfinance: Characteristics of Microfinance Institutions Involved in Environmental Management	Journal of Business Ethics
44	Cull, Harten, Nishida, Rusu, & Bull (2015)	Benchmarking the financial performance, growth, and outreach of greenfield MFIs in Africa	Emerging Markets Review
45	Bos & Millone (2015)	Practice What You Preach: Microfinance Business Models and Operational Efficiency	World Development
46	Wijesiri, Viganò, & Meoli (2015)	Efficiency of microfinance institutions in Sri Lanka: a two-stage double Bootstrap DEA approach	Economic Modelling
47	Wijesiri & Meoli (2015)	Productivity change of microfinance institutions in Kenya: A bootstrap Malmquist approach	Journal of Retailing and Consumer Services
48	Wijesiri (2016)	Weathering the storm: Ownership structure and performance of MFI in the wake of the global financial crisis	Economic Modelling
49	Lopatta & Tchikov (2016)	Do microfinance institutions fulfil their promise?	Applied Economics

		Evidence from cross-country data	
50	Mia & Chandran (2016)	Measuring Financial and Social Outreach Productivity of Microfinance Institutions in Bangladesh	Social Indicator Research
51	Blanco-Oliver, Irimia-Dieguez, & Reguera-Alvarado (2016)	Prediction-oriented PLS path modelling in microfinance research	Journal of Business Research
52	Abdullah & Quayes (2016)	Do women borrowers augment financial performance of MFIs	Applied Economics
53	Forcella & Hudon (2016)	Green Microfinance in Europe	Journal of Business Ethics

As Table 2 suggests, this study reviews the articles from 1994 to 2016. The earliest article (Yaron, 1994) follows none of the stages mentioned, since the study is considered a seminal work in microfinance. In addition, as the research titles show, "performance" is not mentioned in the title of various studies; rather, it is hidden in the concept of these articles.

The frequency of journals and areas suggests that the reviewed articles be classified into three main categories, of "economics and development economics", "operational research or management science", and "business and finance".

2.1.3. Collecting studies with application of DEA in microfinance

From a methodological standpoint, this review follows the structure of the review paper by Brau and Woller (2004). We build the main sample of the to-review list with an emphasis on DEA, and selecting the following keywords, "microfinance institution efficiency" and "Data Envelopment Analysis or DEA".

The main sample of this review, as extracted from the first strand of keywords, is represented in Table 3. This is a list of MFI studies that applied DEA, starting from 2006 to the most recent article in 2016. These articles are reviewed from the viewpoints of journal, details of applied DEA method, variable selection, and complementary method, along with DEA. As the variable/ratio measurements and the method of SFA can address similar objectives with DEA, reviewing key studies with application of variable/ratio and SFA is of value in order to compare and contrast the application of three methods of DEA for MFI studies.

Therefore, key SFA and ratio studies that have evaluated the performance of MFI are reviewed and presented in Table 4. Then, the application of advanced DEA models in non-MFI studies is reviewed. In this way, we attempt to find DEA models that are able to overcome the deficiencies of existing DEA studies in the field of MFI. These studies are listed in Table 5.

Table 3 Reviewed MFI studies with application of DEA

	Author and year	*Title*	*Journal/ Place published*
1	Nghiem, Coelli, & Rao (2006)	The efficiency of microfinance in Vietnam: Evidence from NGO schemes in the north and the central regions	International Journal of Environmental, Cultural, Economic and Social Sustainability
2	Gutierrez-Nieto, Serrano-Cinca, & Molinero (2007)	Microfinance institutions and efficiency	OMEGA
3	Bassem (2008)	Efficiency of microfinance institutions in the Mediterranean: an application of DEA	Transition Studies Review
4	Gutiérrez-Nieto et al. (2009)	Social efficiency in microfinance institutions	Journal of the Operational Research Society
5	Haq, Skully, & Pathan (2010)	Efficiency of microfinance institutions: A data envelopment analysis	Asia-Pacific Financial Markets
6	Usman (2011)	Efficiency Analysis of Micro-Finance Institutions in Pakistan	Munich Personal RePEc Archive
7	Jayamaha (2012)	Efficiency of small financial institutions in Sri Lanka using data envelopment analysis	Journal of Emerging Trends in Economics and Management Sciences

8	Hassan, Sanchez, & Ngene (2012)	Scales and technical efficiencies in Middle East and North African (MENA) micro financial institutions	International Journal of Islamic and Middle Eastern Finance and Management
9	Gebremichael & Rani (2012)	Total factor productivity change of Ethiopian microfinance institutions (MFIs): A Malmquist Productivity Index approach (MPI)	European Journal of Business and Management
10	Moya Musa, Akodo, Mukooza, Kaliba, & Mbarika (2012)	Impact of investment in information and communication technology on performance and growth of microfinance institutions in Uganda	Applied Econometrics and International Development
11	Kipesha (2012)	Efficiency of microfinance institutions in East Africa: A data envelopment analysis	European Journal of Business and Management
12	Kipesha (2013)	Production and intermediation efficiency of microfinance institutions in Tanzania	Research Journal of Finance and Accounting
13	Segun & Anjugam (2013)	Measuring the Efficiency of Sub-Saharan Africa's Microfinance Institutions and its Drivers	Annals of Public and Cooperative Economics
14	Tahir & Tahrim (2013)	Efficiency Analysis of Microfinance Institutions in ASEAN: A DEA Approach	Business Management Dynamics

15	Piot-Lepetit & Nzongang (2014)	Financial sustainability and poverty outreach within a network of village banks in Cameroon: A multi-DEA approach	European Journal of Operational Research
16	Bassem (2014)	Total factor productivity change of MENA microfinance institutions: A Malmquist productivity index approach	Economic Modelling
17	Abdelkader, Hathroubi, & Jemaa (2014)	Microfinance Institutions' Efficiency in the MENA region: a Bootstrap-DEA approach	Research Journal of Finance and Accounting
18	Widiarto & Emrouznejad (2015)	Social and financial efficiency of Islamic microfinance institutions: A data envelopment analysis application.	Socio-Economic Planning Sciences
19	Wijesiri et al. (2015)	Efficiency of microfinance institutions in Sri Lanka: a two-stage double bootstrap DEA approach	Economic Modelling
20	Wijesiri & Meoli (2015),	Productivity change of microfinance institutions in Kenya: A bootstrap Malmquist approach	Journal of Retailing and Consumer Services
21	Tahir and Tahrim (2015)	Efficiency and productivity analysis of microfinance institutions in Cambodia: A DEA approach	International Review of Business Research Papers

22	Lebovics, Hermes, & Hudon (2016)	Are Financial and Social Efficiency Mutually Exclusive? A Case Study of Vietnamese Microfinance Institutions	Annals of Public and Cooperative Economics
23	Wijesiri (2016)	Weathering the storm: ownership structure and performance of microfinance institutions in the wake of the global financial crisis	Economic Modelling
24	Mia & Chandran (2016)	Measuring Financial and Social Outreach Productivity of Microfinance Institutions in Bangladesh	Social Indicator Research

Table 4 MFIs studied that measure efficiency with non-DEA method

	Author and year	Method	Journals
1	Wahid (1994)	Variable/ ratio measure	American Journal of Economics and Sociology
2	Mersland & Strom (2009)	Variable/ ratio measure	Journal of Banking & Finance
3	Manos & Yaron (2009)	Variable/ ratio measure	Canadian Journal of Development Studies
4	Strom et al. (2014)	Variable/ ratio measure	Journal of Banking & Finance
5	Hernández-Trillo, Pagán, & Paxton (2005)	SFA	Review of Development Economics
6	Gregoire & Tuya (2006)	SFA	Latin American Business Review
7	Paxton (2007)	SFA	Oxford Bulletin of Economics & Statistics
8	Hermes et al. (2011)	SFA	World Development
9	Oteng-Abayie, Amanor, & Frimpong (2011)	SFA	African Review of Economics and Finance
10	Kebede & Berhanu (2012)	SFA	Journal of African Economies
11	Hartarska & Mersland (2012)	SFA	European Financial Management

12	Servin et al. (2012)	SFA	Journal of Banking & Finance
13	Hartarska et al. (2013)	SFA	Journal of Banking & Finance
14	Hartarska et al. (2014)	SFA	American Journal of Agricultural Economics
15	Bos & Millone (2015)	SFA	World Development

Table 5 Non-MFI studies with inspiring application of DEA

	Method	Author and year	Method of performance evaluation
1	Network DEA	Holod & Lewis (2011)	Journal of Banking & Finance
2		Matthews (2013)	OMEGA
3	Slack-based DEA with undesirable output	Arabi, Munisamy, & Emrouznejad (2015)	Energy
4	Window DEA	Asmild, Paradi, Aggarwall, & Schaffnit (2004)	Journal of Productivity Analysis
5		Webb (2003)	International Journal of the Economics of Business
6	Alternative MI	Oh, Oh, & Lee (2017)	Empirical Economics
7	MI with unbalanced panel	Paleckova (2015)	Journal of Applied Economic Sciences
8		Paleckova (2017)	Financial Environment and Business Development

2.2. Synthesis and review

2.2.1. Systematic analysis of performance

To answer the main question of the systematic review, "how has the performance literature changed in terms of performance dimension, data, and performance-related field?", the analysis of the first review strand is carried out through three main channels. Firstly, we investigate the emphasised dimension of performance that each study evaluated. Then, the data are studied. Thirdly, the non-performance fields that have been studied in the literature are discussed.

2.2.1.1. Emphasised dimension

In general, the double bottom-line objective of MFIs has caused the studies to take both financial and social aspects into the consideration of performance evaluation. More recently, the third bottom line, environmental responsibility, is added to the performance evaluation. Therefore, in the first strand of analysis, as represented in Table 6, we inspect the literature from the three bottom lines view on MFIs.

Based on triple bottom-line objectives of MFIs, the emphasised dimensions are broken down into financial, social and environmental performance. Furthermore, in line with our discussion and as suggested by Sink and Tuttle (1989) and Tangen (2005), we clarify the studies' definitions and measures of financial performance. In addition, social performance is broken down into depth, breadth, quality, length, and scope of "outreach", as suggested by (Navajas et al., 2000).

Table 6 Performance dimensions and details

	Author and year	Emphasized dimension	Performance dimension details
1	Yaron (1994) *	F and S	F: Profitability (sustainability) S: Depth and Quality
2	Mosley & Hulme (1998)	F and S	F: profitability (sustainability) S: Quality (impact)
3	Morduch (1999b)	F and S	F: Profitability (Sustainability) S: Depth and Breadth
4	Morduch (1999a)	F and S	F: Profitability (Sustainability) S: Depth, Breadth and Quality
5	Conning (1999)	F and S	F: Profitability (Sustainability) S: Quality
6	Navajas et al. (2000)	S	S: Depth, Quality, Breadth, Length, and Scope of social output, value and cost to users
7	Morduch (2000)	F and S	F: Profitability (sustainability) S: Depth and Breadth of outreach

8	Park & Ren (2001)	F and S	F: Profitability (Sustainability)
			S: Depth and Quality
9	MkNelly & Kevane (2002)	S	S: Quality
10	Hartarska (2005)	F and S	F: Profitability (Sustainability)
			S: Depth and Breadth of outreach
11	Coleman (2006)	S	S: Depth and Quality
12	Cull & Morduch (2007)	F and S	F: Profitability (Sustainability)
			S: Depth and Breadth
13	Hartarska & Nadolnyak (2007)	F and S	F: Profitability (Sustainability)
			S: Depth and Breadth
14	Copestake (2007)	F and S	F: Profitability (Sustainability)
			S: Depth, Breadth and Quality
15	Gutiérrez-Nietoa et al. (2007)	F and S	F: Efficiency
			S: Depth and Breadth
16	Gutiérrez-Nieto et al. (2009)	F and S	F: Efficiency
			S: Depth and Breadth

17	Mersland & Strom (2009)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
18	Mersland & Strøm (2010)	F and S	F: Cost efficiency, Profitability
			S: Depth, Breadth and Quality
19	Mersland et al. (2011)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
20	Cull et al. (2011)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
21	Hudon & Traca (2011)	F and S	F: Productivity, Efficiency
			S: Depth
22	Hermes et al. (2011)	F and S	F: Efficiency
			S: Depth
23	Ahlin et al. (2011)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
24	Galema et al. (2012)	F	F: Profitability (sustainability)
25	Servin et al. (2012)	F and S	F: Efficiency
			S: Depth and Breadth

26	Bogan (2012)	F and S	F: Efficiency, Profitability (sustainability)
			S: Depth and Breadth
27	Quayes (2012)	F and S	F: Profitability (sustainability)
			S: Depth
28	Kebede & Berhanu (2012)	F and S	F: Efficiency (cost efficiency)
			S: Breadth
29	Hartarska & Mersland (2012)	F and S	F: Efficiency (cost efficiency)
			S: Breadth
30	Vanroose & D'Espallier (2013)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
31	Mersland et al. (2013)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
32	Louis et al. (2013)	F and S	F: Efficiency, Profitability (sustainability)
			S: Depth and Breadth
33	Hartarska et al. (2013)	F and S	F: Efficiency (cost efficiency)
			S: Breadth
34	Allet (2014)	F and S and E	F: Legitimation (stakeholder pressure)

			S: Social responsibility
			E: MFEPI
35	Hartarska et al. (2014)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
36	Strom et al. (2014)	F and S	F: Profitability (sustainability)
			S: Breadth
37	Bassem (2014)	F and S	F: Productivity dynamics
			S: Breadth
38	Cull et al. (2014)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
39	Barry & Tacneng (2014)	F and S	F: Efficiency, Profitability (sustainability)
			S: Depth and Breadth
40	Piot-Lepetit & Nzongang (2014)	F and S	F: profitability, efficiency/productivity
			S: Worth of outreach, Cost of outreach, Length of outreach, Breadth of outreach, Depth of outreach, Outreach to community
41	Quayes (2015)	F and S	F: profitability (sustainability)
			S: Depth

42	Casselman et al. (2015)	S	S: Social orientation, Depth, Breadth
43	Allet & Hudon (2015)	F and S and E	F: Profitability (sustainability)
			S: Depth and Breadth
			E: 5 dimensions of performance.
44	Cull et al. (2015)	F and S	F: Profitability (sustainability), productivity
			S: Depth
45	Bos & Millone (2015)	F and S	F: Efficiency technical efficiency
			S: Depth and Breadth
46	Wijesiri et al. (2015)	F and S	F: Efficiency
			S: Breadth
47	Wijesiri & Meoli (2015)	F and S	F: Productivity dynamics
			S: Breadth
48	Wijesiri (2016)	F and S	F: Productivity dynamics
			S: Depth and Breadth
49	Lopatta & Tchikov (2016)	F and S	F: Efficiency, Profitability (sustainability)
			S: Depth and Breadth
50	Mia & Chandran (2016)	F and S	F: Productivity dynamics

			S: Depth and Breadth
51	Blanco-Oliver et al. (2016)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
52	Abdullah & Quayes (2016)	F and S	F: Profitability (sustainability)
			S: Depth and Breadth
53	Forcella & Hudon (2016)	F and S and E	E: Environmental dimension of performance

F: Financial   S: Social   E: Environmental

As noted in Table 6, financial and social aspects of performance are the two dimensions that have been studied by both early and recent literature. However, the environmental dimension of performance received the attention of only few recent studies (Allet, 2014; Allet & Hudon, 2015; Forcella & Hudon, 2016).

According to Allet (2012), this under-emphasis has three main causes rooted in data availability. Firstly, many MFIs consider environmental responsibility as a part of their social responsibility. Secondly, most of the MFIs pay minimal attention to reporting data on environmental policies. Thirdly, as social-driven institutions, many MFIs struggle with financial performance and consider environmental policies as extra effort that distracts them from being financially sustainable. Therefore, more details are provided about data evolution in the next chapter.

Moreover, as the fourth column suggests, only a few recent studies have addressed the productivity dynamics of MFIs. The quality of social performance has also received inadequate attention from scholars, and is measured only by 9 out of 53 studies that are Coleman (2006), Conning (1999), Copestake (2007), Mersland and Strøm (2010), MkNelly and Kevane (2002), Morduch (1999a), Mosley and Hulme (1998), Navajas et al. (2000) and Yaron (1994).

The insufficiency of studies on environmental performance and quality of outreach is rooted in data access, as discussed in the next section.

2.2.1.2. Access to data, data scope and data dynamics

In terms of data access, Table 7 clearly shows that the provision and access to data has expanded over years. Earlier literature studied only a few initial MFIs such as the Bank for Agriculture and Agricultural Cooperative (BAAC) in Thailand, Grameen Bank of Bangladesh, and the Badan Kredit Kacamatan and The Bank Rakyat Indonesia Unit Desa in Indonesia, such as Morduch (1999a) and Yaron (1994). However, more recently the growth of the industry has

led to the establishment of rating agencies and data platforms that provide access to broader information for regional and even global analysis.

Starting from Hartarska and Nadolnyak (2007), more than half of the studies - 28 out of 53 -, such as Ahlin et al. (2011), Allet (2014), Bogan (2012), Hartarska and Nadolnyak (2007), Hartarska et al. (2014) and Wijesiri (2016)) applied global-scale data. The number of MFIs representing the sample of world MFIs, however, varies significantly, from 100 MFIs by Hudon and Traca (2011) to 2382 MFIs by Lopatta and Tchikov (2016). Considering the contributions of these studies, as presented in Table 8 discussed in next section, it is found in the present review that the global studies have all aimed to find a general rule in Microfinance: for example, if there is a trade-off between social and financial performance, such as Bos and Millone (2015), Hermes et al. (2011), Lopatta and Tchikov (2016), Louis et al. (2013) and Quayes (2015); or if MFIs have drifted away from their social mission, such as Louis et al. (2013), Mersland et al. (2011) and Vanroose and D'Espallier (2013).

Table 7 Data scope, source and dynamics

	Author and year	Sample size	Region	Dynamics/statics- years covered	Data source
1	Yaron (1994) *	4 earliest MFIs	Indonesia Bangladesh Thailand	Conceptual study S	Author's survey
2	Mosley & Hulme (1998)	13 MFIs	7 countries Bolivia, Indonesia, Sri-Lanka Kenya India Malawi	D 1991-1993	Field survey (Hulme & Mosley, 1996)
3	Morduch (1999b)	Grameen Bank	Bangladesh	D 1985-1997	www.grameen.com
4	Morduch (1999a)	4 MFIs	3 countries Indonesia Bangladesh Bolivia	D 1985- 1996	www.grameen.com BRI annual data

5	Conning (1999)	72 MFIs	3 countries Indonesia Thailand Bolivia	S 1998	Micro-banking Bulletin
6	Navajas et al. (2000)	5 MFIs	Bolivia	S 1992	Author's survey, National poverty assessment
7	Morduch (2000)	----	----	-----	From unpublished notes of Don Johnston
8	Park & Ren (2001)	3 MFIs	China	D 1997-1999	Funding the Poor Cooperative (FPC) Rural Development Institute (RDI) Chinese Academy of Social Sciences (CASS)
9	MkNelly & Kevane (2002)	65 credit union programs	Burkina Faso	D 1993-2000	Author's survey Microcredit Summit (Fruman & Paxton, 1998)

10	Hartarska (2005)	110 MFIs	Eastern Europe countries	D 1998, 2001, 2002	Microfinance centre for central Europe and newly independent state (MFC)
11	Coleman (2006)	2 MFIs	Northern Thailand	D 1995–1996	Author's survey
12	Cull & Morduch (2007)	124 MFIs	Global Analysis 49 countries	D 1999-2002	Micro-Banking Bulletin
13	Hartarska & Nadolnyak (2007)	114 MFIs	Global Analysis 62 countries	D (not mentioned)	MIX
14	Copestake (2007)	17 MFIs	9 countries	D 2000-2003	(Copestake, Greeley, Johnson, Kabeer, & Simanowitz, 2005)
15	Gutiérrez-Nietoa et al. (2007)	30 MFIs	Latin America region	S 2003	Micro-rate
16	Gutiérrez-Nieto et al. (2009)	89 MFIs	Latin America	S 2003	MIX
17	Mersland & Strom (2009)	278 MFIs	Global Analysis 60 countries	D 1998-2007	Ratingfund

18	Mersland & Strøm (2010)	379 MFIs	Global Analysis 74 countries	D 1999-2007	Ratingfund
19	Mersland et al. (2011)	379 MFIs	Global Analysis 73 countries	D 2001-2008	Ratingfund
20	Cull et al. (2011)	346 MFIs	Global Analysis 67 developing countries	S 2003 or 2004	MIX
21	Hudon & Traca (2011)	100 MFIs	Global analysis	S (not mentioned)	PlaNet Rating, Microfinanza
22	Hermes et al. (2011)	435 MFIs	Global analysis	D 1997-2007	MIX
23	Ahlin et al. (2011)	373 MFIs	Global analysis 74 countries	D 1996-2007	MIX
24	Galema et al. (2012)	280 MFIs	Global analysis 60 countries	D 2000-2007	Ratingfund
25	Servin et al. (2012)	315 MFIs	18 Latin America	D 2003–2009	MIX
26	Bogan (2012)	574 MFIs	Global analysis	D 2003 and 2006	MIX

27	Quayes (2012)	702 MFIs	Global Analysis 83 countries	S not mentioned	MIX
28	Kebede & Berhanu (2012)	14 MFIs and 7 Commercial Bank	Ethiopia	D 2001-2008	Association of the Ethiopian MFIs (AEMFIs) MIX
29	Hartarska & Mersland (2012)	155 MFIs	Global Analysis 45 countries	D 2000-2007	MicroRate, Microfinanza, Planet Rating, Crisil, and M-Cril, Ratingfund
30	Vanroose & D'Espallier (2013)	1073	Global Analysis	D 1997-2006	MIX, World Bank, (Beck, Demirguc-Kunt, & Peria, 2007)
31	Mersland et al. (2013)	405 MFIs	Global Analysis 73 countries	D 2001- 2010	CGAP's Rating Fund
32	Louis et al. (2013)	650 MFIs	Global Analysis 88 countries	D 2009-2011	MIX
33	Hartarska et al. (2013)	989 MFIs	Global Analysis 69 countries	D 1998–2010	Ratingfund

34	Allet (2014)	160 MFIs	Global Analysis	S 2011	Authors survey and Interviews.
35	Hartarska et al. (2014)	266 MFIs	Global Analysis 50 countries	D 1998–2009	Ratingfund, MIX, Individual MFI's websites.
36	Strom et al. (2014)	329 MFIs	Global Analysis 73 countries	D 1998-2008	Micro Rate, Microfinanza, Planet Rating, Crisil M-Cril.
37	Bassem (2014)	33 MFIs	Middle East and North Africa	D 2006–2011	MIX
38	Cull et al. (2014)	238 MFIs	38 developing countries	D 1991-2000	Combine data from Beck et al. (2007), Micro-banking Bulletin (MBB) MIX
39	Barry & Tacneng (2014)	200 MFIs	30 Sub Saharan African countries	D 2004-2007	MIX

40	Piot-Lepetit & Nzongang (2014)	52 MFIs	Cameroon	S 2009	ADAF (Appropriate Development for Africa Foundation)
41	Quayes (2015)	247 MFIs	Global Analysis 87 countries	D 2003-2006	MIX
42	Casselman et al. (2015)	140 MFIs	47 countries	S 2011	MIX
43	Allet & Hudon (2015)	160 MFIs	Global Analysis	S 2011	Author's survey MIX
44	Cull et al. (2015)	910 MFIs	Global Analysis	D 2005-2009	IFC (international finance corporation) MIX
45	Bos & Millone (2015)	1146 MFIs	Global Analysis	D 2003-2010	MIX
46	Wijesiri et al. (2015)	36 MFIs	Sri Lanka	S 2010	MIX
47	Wijesiri & Meoli (2015)	20 MFIs	Kenya	D 2009-2012	MIX
48	Wijesiri (2016)	298 MFIs	Global Analysis	D 2005-2011	MIX

49	Lopatta & Tchikov (2016)	2382 MFIs	Global Analysis 119 countries	D 1995–2012	MIX
50	Mia & Chandran (2016)	162 MFIs	Bangladesh	D 2007-2012	MIX
51	Blanco-Oliver et al. (2016)	563 MFIs	Global Analysis	S 2012	MIX
52	Abdullah & Quayes (2016)	1126 MFIs	Global Analysis 91 countries	D 2003-2012	MIX
53	Forcella & Hudon (2016)	415 MFIs in Europe	Europe	S 2013	Prior research report by the author, Online survey

In terms of the country of studies, it can be seen that Bangladesh is the most emphasized country in both early and recent studies, such as Mia and Chandran (2016), Morduch (1999a, 1999b) and Yaron (1994). Bolivia is also paid attention, but only by earlier studies such as Conning (1999), Morduch (1999a) and Mosley and Hulme (1998).

Regional evaluation of MFIs has also received interest from microfinance scholars. Gutiérrez-Nieto et al. (2009), Gutiérrez-Nietoa et al. (2007) and Servin et al. (2012) studied microfinance in Latin America. Bassem (2014) evaluated the performance of microfinance in Middle East and North Africa region; while Forcella and Hudon (2016) and Hartarska (2005) studied European microfinance.

In assessing the scope and geographical location of the reviewed studies, we should bear in mind that the availability of data in the regions plays a key role, especially for secondary data collection. Except for few exceptions, that are the studies done by Allet and Hudon (2015), Coleman (2006), Forcella and Hudon (2016) and Navajas et al. (2000), other studies applied secondary data. This is due to the ease of access to quality, transparent and varied information provided by data platforms such as Micro-Banking Bulletin, as applied by Conning (1999) and Cull and Morduch (2007), and Microfianza or rating agencies such as the planet rating as applied by Hartarska and Mersland (2012), Hudon and Traca (2011) and Strom et al. (2014).

The most recent studies have been unanimously applying the Microfinance Information Exchange (MIX) as a database. This is a non-profit organization, established in 2004, that provides data and intelligence on microfinance institutions. This database increased the transparency of data over time as one of its main strategies (Gonzalez & Rosenberg, 2006), and therefore is applied as a reliable platform with ever-growing popularity amongst researchers. 27 out of 53 reviewed studies such as Abdullah and Quayes (2016), Ahlin et al. (2011) and Mia and Chandran (2016) used the MIX as source of data.

From the dynamism point of view, it is seen that the application of panel data is common both in early and recent studies, as the microfinance institutions have faced delayed social and financial outcomes (Bassem, 2014). However, taking both Tables 6 and 7 into consideration, we find only three studies with consideration of a triple bottom-line objective of MFIs (Allet, 2014; Allet & Hudon, 2015; Forcella & Hudon, 2016) that have applied static data. This indicates the lack of dynamic evaluation of performance with simultaneous consideration of social, financial and environmental aspects.

2.2.1.3. Related fields

Studying the performance of MFIs has been a part of other objectives in most of the reviewed literature. A substantial number of scholars measured performance to tackle the debate on the existence of a trade-off between financial and social performance of MFIs. As represented in Table 8, this objective was first met by Mosley and Hulme (1998) and continued by many other early and recent studies such as Conning (1999), Park and Ren (2001), Bos and Millone (2015) and Lopatta and Tchikov (2016). Over time, trade-off studies have evolved in terms of data size, and inspecting various mediating and moderating factors. For example, Lopatta and Tchikov (2016) applied the largest dataset of all studies by using the sample comprised of 2382 MFIs from 119 countries over 17 years, and stated that trade-off can be tackled by qualitative risk assessments of MFIs, even at the international level, and that, in turn, MFIs with no trade-off positively help the growth and development of economies.

The second frequent objective that has been studied in the literature, in conjunction with performance, is "mission-drift". Lopatta and Tchikov (2016), Louis et al. (2013), Mersland and Strøm (2010) and Vanroose and D'Espallier (2013) investigated whether MFIs have drifted away from their main mission, by testing the correlation between financial performance and depth of outreach. This debate also ends with the holistic study of the largest sample of MFIs, mentioned above, by Lopatta and Tchikov (2016), who concluded that MFIs with qualitative

risk assessment can achieve cost efficiency and operational self-sufficiency, while also increasing the depth of outreach.

Moreover, the factors that determine performance have received the attention of a growing number of studies. Corporate governance is the most emphasized factor in the literature, as considered by such studies as Barry and Tacneng (2014), Hartarska (2005) and Hartarska and Mersland (2012). Subsidy is studies by Bogan (2012), Forcella and Hudon (2016), Hudon and Traca (2011), Morduch (1999b) and Yaron (1994). Institutional type is studied by Barry and Tacneng (2014), Blanco-Oliver et al. (2016), Cull et al. (2014); Wijesiri and Meoli (2015) and Wijesiri et al. (2015). Also, Allet and Hudon (2015), Cull et al. (2014), Forcella and Hudon (2016) and Quayes (2015) studied the size of MFIs.

According to Table 8, technology change and degree of capitalisation are understated by prior researchers. The impact of technology, in particular, is vital, as over the past few years, MFI performance has been affected by the rapid movement in technology, innovation and supportive policy reforms (Wijesiri & Meoli, 2015).

Table 8 Related fields and contributions

	Author and year	*Related fields*	*Contribution*
1	Yaron (1994) *	- Subsidy	- For the first time, proposed framework for performance evaluation based on social outreach and financial sustainability
2	Mosley & Hulme (1998)	- Design's features - Trade-off	- Meticulously assessed the cost-effective approach of Bank Rakyat Indonesia as the best practice that leads MFIs to be both profitable and socially successful.
3	Morduch (1999b)	- Impact of subsidy - Trade-off	- Recalculated repayment rate and indicators of success for Grameen Bank. - Recognized the benefits of and challenges faced by MFIs.
4	Morduch (1999a)	- Trade-off	- Analysed the win-win approach for MFIs to alleviate poverty and have full cost recovery.
5	Conning (1999)	- Design features - Trade-off - Leverage - Moral hazard between borrowers - Contract design problem	- Scrutinized the impact of MF on details of poverty such as household income from multiple aspects. - Relationship between growth and poverty alleviation.

6	Navajas et al. (2000)	- Macro-economics and socio-economic factors affected by MFIs	- Introduced six aspects of social performance and studied the trade-off between them.
7	Morduch (2000)	- Trade-off -Subsidizing policies	- Rethought microfinance and constructed foundations for the next wave of microfinance innovation. - Mentioned the lessons of failed programs in the past.
8	Park and Ren (2001)	- Design of microfinance programs - Government involvement - Regional situation of MFIs clients (mountainous or flood plains) - Trade-off - Design features	- The earliest study on assessment of Chinese MFIs. - Studied remote locations and agricultural projects.
9	MkNelly & Kevane (2002)	- Socio-economic factors of development - Credit market	- Examined different methodologies and designs. - Provides suggestions on development of appropriate credit union targeting education.
10	Hartarska (2005)	- Governance mechanisms - Management compensation - Board effectiveness	- Studied the significance of board structure, board independence, and board characteristics.

		- Contract design, risk	
		- Moral hazard	
11	Coleman (2006)	- Loyalty of members	- Empirically proved the effect of MF on welfare of Northern Thailand.
		- Household welfare	- Suggested valid policy implications based on the findings in terms of imposing membership criteria, targeting the poor, health, and education.
12	Cull and Morduch (2007)	- Economies of information	- Studied the governance of MFIs by linking Banking, NGOs and corporate governance literature.
		- Governance of MFIs	- Assessed the impact of governance mechanism on sustainability and outreach.
13	Hartarska & Nadolnyak (2007)	- Management quality	- Adopted a positive approach to see whether regulated MFIs achieve better outreach and sustainability, controlling for the diverse environments.
		- MFI characteristics	
		- Regulatory status	
14	Copestake (2007)	- Impact assessment	- Investigated the social performance, performance management and performance preference.
		- Social Performance management	
		- Social Performance preference	- Applied a mix of more rigorous impact assessment for public policy and less rigorous impact assessment for internal use of financial institutions themselves.
		- Mission drift	

15	Gutiérrez-Nietoa et al. (2007)	- Country effect - The best practice MFIs - The most suitable specification of MFIs inputs and outputs.	- Studied performance of MFIs using relative efficiency by DEA. - Presented clarification on the selection of variables for the performance measurements. - Presented overall ranking of MFIs in terms of the use they make of inputs and outputs. - Revealed the features that distinguish NGOs from non-NGO institutions.
16	Gutiérrez-Nieto et al. (2009)	- Social performance indicators	- Measured social performance by calculating series of comparative indexes of DEA.
17	Mersland & Strom (2009)	- Ownership - Corporate governance - Lending methodology and regulation	- Collected data from third-party sources, which is more reliable than self-reported data. - Studied bank regulation and governance impact on MFIs performance.
18	Mersland & Strøm (2010)	- Mission drift - Country effect - Trade-off	- Studied mission drift and the relationship between financial performance and social performance using large dataset from third-party sources.
19	Mersland et al. (2011)	- Internationalization impact - Trade-off	- Indicated how internationalization can affect the social performance and the trade-off.
20	Cull et al. (2011)	- The impact of supervision	- Empirically analysed the effects of prudential supervision on performance.

			- Reliable dataset from high quality interviews.
21	Hudon & Traca (2011)	- Moral hazard argument	- Addressed the issue of the acceptable level of subsidies.
		- Donors information	- Examined Yaron's subsidy-dependent index.
		- Marginal efficiency-tax	- Analysed the impact of efficiency tax on productivity.
		- Subsidy (smart subsidy)	
22	Hermes et al. (2011)	- Trade-off	- Addressed the effect of MFIs efficiency at the macro (regional) level.
		- Macro-level impact of efficiency	
23	Ahlin et al. (2011)	- Country level context	- Studied the impact of macroeconomic and macro-institutional environment
		- Micro-institutional features	on financial sustainability and its components, and extensive and intensive
		- Growth of MFIs	growth using large dataset.
24	Galema et al. (2012)	- Corporate governance	- Studied corporate governance and CEO power in MFI risk taking in
		- Performance viability	developing countries.
		- Managerial discretion	- Studied the roots of MF failures from the viewpoint of corporate
		- MFIs' growth	governance.
		- Managerial direction	
		- Risk taking	

25	Servin et al. (2012)	- Ownership - Technology - Catch-up - Intra-firm technical efficiency Inter-firm technical efficiency	- Measured catch-up and inter-types efficiency -
26	Bogan (2012)	- Capital structure - Life-cycle theory - Profit-incentive theory - Smart subsidy	- Studied the link between capital structure and MFI performance. - Studied the short-term vs long-term impact of any policy during an economic crisis.
27	Quayes (2012)	- Trade-off - Trade-off between breadth and depth of outreach	- Examined the existence of the trade-off in a global scope.
28	Kebede & Berhanu (2012)	- MFIs vs commercial banks	- Studied the performance and challenges of MFIs vs commercial banks.
29	Hartarska & Mersland (2012)	- Governance mechanism - Risk taking - Board competition	- Studied the impact of governance. - Applied quasi-intermediation approach to study MFIs as financial intermediaries.

		- External and internal governance	
30	Vanroose & D'Espallier (2013)	- Financial sector development - Mission drift - Competition between commercial banks and MFIs	- Studied the impact of financial system improvement on MFIs' performance.
31	Mersland et al. (2013)	- Religion impact on performance of MFIs	- Studied the performance drivers: portfolio yield, cost of funds, operational cost.
32	Louis et al. (2013)	- Mission drift - Trade-off	- Studied trade-off and mission drift using graphical plotting technique for the heterogeneity among MFIs about the different input variables.
33	Hartarska et al. (2013)	- Input price elasticity - Scale economies	- Studied the scale efficiency of MFIs. - Analysed the elasticity of substitution among inputs to illuminate how MFIs combine inputs to provide financial services.
34	Allet (2014)	- Corporate Social Responsibility - Ecological responsiveness - Environmental performance - Motivations behind the green MFIs.	- Studied the motivations for MFIs of going green, in terms of responding to investors' or donors' pressure (legitimation as the dominant driver). - Studied the incentive- and support-based policies and positive strategies of environmental management.

35	Hartarska et al. (2014)	- Gender of CEO - Lending approach	- Studied the gender diversity at the level of top MFI management.
36	Strom et al. (2014)	- Female leadership	- Studied the impact of female leadership, by CEO, chair or director, on performance, using hand-collected data from third-party rate reports of 73 countries.
37	Bassem (2014)	- Catch-up - Efficiency change - Technology change	- Studied the productivity dynamics, catch-up and technological advance.
38	Cull et al. (2014)	- Bank penetration - Institutional type - Regulation in banks - Impact of bank on microfinance - Size - Market niche - Industrial organization - Economic environment	- Studied the industrial organization of traditional banking and micro-banking. - Studied diverse types of MFIs, the indirect channel of regulating commercial banks through which the access to finance can increase, and the positive spill-over that regulation in Banks can have to MFIs.

39	Barry & Tacneng (2014)	- Governance impact - Institutional quality - Institutional type	- Studied performance through risk-adjusted profitability.
40	Piot-Lepetit & Nzongang (2014)	- Trade-off - Best practice MFI	- Applied DEA for better understanding by managers of the best-practice and relative efficiency of MFIs. - Covered several aspects of social performance.
41	Quayes (2015)	- The impact of size - Trade-off	- Proposed a new indicator for the depth of outreach that normalizes the variation in income across countries (ALBGDP)
42	Casselman et al. (2015)	- Faith-based organizations - Base of Pyramid (BoP) market - Intent, process and the result of social mission - Impact of religion - Ethical behaviour	- Conceptualized and empirically studied the development and understanding of the differential social performance and religiosity MFIs in BoP markets.
43	Allet & Hudon (2015)	- Corporate social responsibility - Size - Legal status	- Empirically studied MFIs' environmental performance to provide insight into the drivers and barriers to MFI's involvement in environmental management.

44	Cull et al. (2015)	- Benchmarking - Success of greenfield strategy in Sub-Saharan Africa - Mobile financial services	- Studied performance from all aspects of productivity, growth and profitability. - Studied the greenfield strategy, and informed the expectations of corresponding policy makers.
45	Bos & Millone (2015)	- Trade-off - Social management	- Studied performance considering different output mixes, resulting from maximizing social and/or financial performance. - Decomposed MFIs' output and evaluated efficiency, preferences and output mixes.
46	Wijesiri et al. (2015)	- MFI age - Institutional type - Effect of the degree of capitalization - Effect of profitability on social and financial efficiency	- Measured efficiency using bias-corrected method, which minimised the measurement error.
47	Wijesiri & Meoli (2015)	- Technical change - Technology change - Type of MFI effect - Managerial efficiency	- Measured productivity growth using bias-corrected approach. - Studied the impact of control variables by bias-corrected method which reduces the sample noise.

		- Profitability effect	- Decomposed the source of productivity change in terms of efficiency change and technological advance.
48	Wijesiri (2016)	- Ownership types - The pattern of productivity growth - Financial crisis	- Studied productivity growth considering undesirable output and different ownership types. - Studied the ownership forms and performance in financial crises.
49	Lopatta & Tchikov (2016)	- Economic development - Trade-off - Mission-drift - Qualitative risk assessments	- Studied the interdependencies between the concept of microfinance and economic development.
50	Mia & Chandran (2016)	- Technical efficiency - Technology change - Managerial practice of learning by doing	- Measured overall, financial and social productivity. -Compared the productivity of MFIs, when only provided credit, and when provided savings and credit at the same time.
51	Blanco-Oliver et al. (2016)	- Mediating effect between social impact and financial performance - Risk of default - Effect of type and regulation	- Investigated predictive power that social impact and portfolio quality exert on financial performance, using PLS path model which is prediction-oriented.

52	Abdullah & Quayes (2016)	- Women borrowers effect - Risk of default	- Studied performance and impacting factors using large and long-panel dataset.
53	Forcella & Hudon (2016)	- MFI characteristics - Status, size and region - Subsidy methodology - Credit size - Investors' interest in environment	- Studied the environmental performance (EP) of MFIs in Europe, with a benchmark of MFIs active in developing countries.

2.2.2. Review of the application of DEA in MFI studies

This strand of the review is based on the literature collected and mentioned in Tables 3, 4 and 5. Therefore, we aim to investigate the methodological approaches by the prior studies. As discussed before, we focus on the application of frontier techniques, in particular DEA, in the field of MFIs due to the movement of performance studies toward this method. In the following, this movement is further explained.

2.2.2.1. From non-DEA studies in MFI to non-MFI studies with DEA application

Reviewing some of the key past and recent studies, such as Manos and Yaron (2009), Mersland and Strøm (2009), and Wahid (1994) shows financial performance have been measured using financial ratios or variables, including Return On Asset (ROA), Operational Self-Sufficiency (OSS), portfolio yield, and operational costs. However, the information gained from ratio measurement is partial and misleading (Bassem, 2014); furthermore, ratio measurements lack proper adjustment including subsidy adjustment, inflation adjustment and foreign exchange gain/loss adjustment (Yaron & Manos, 2007). These drawbacks can be overcome by frontier methods that are established to consider the effects of economies of scale, evaluate benchmarks and estimate overall performance (Wijesiri et al., 2015). Amongst these frontier methods, Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA) are the most suitable and common methods for measuring MFI's performance (Kipesha, 2012). SFA is a parametric method that defines production function by applying the Maximum Likelihood method and incorporating composed error term (Drake & Hall, 2003); while DEA is non-parametric, and constructs best practice production function (Jemric & Vujcic, 2002).

Table 4 represents MFI studies that applied SFA between 2005 and 2015. These studies mainly measured cost efficiency of MFIs in terms of the closeness of the MFI's cost frontier to the most efficient one, considering the given technology (Abate, Borzaga, & Getnet, 2014). This can be considered from the view of minimum input use, also known as technical (cost)

efficiency, or the optimum mix of input, also known as allocative efficiency (Battese & Coelli, 1995). The variety of studies that have applied SFA is due to the different cost functions that are defined for the industry, in the form of Cobb-Douglas, Trans-log, or Fourier Flexible functions (Gregoire & Tuya, 2006).

Early MFI studies, such as Gregoire and Tuya (2006), Hartarska and Mersland (2012) and Hermes et al. (2011) applied the SFA model of Battese and Coelli (1995) (BC) based on trans-log or(and) Cobb-Douglas's cost function for balanced or unbalanced panel data.

More advanced SFA models have been applied in studies such as Hartarska et al. (2013), which applied SFA in conjunction with classical Seemingly Unrelated Regressions (SURs). In addition, Paxton (2007) used SFA with non-monotonic marginal effect to measure both efficiency and maximum marginal benefit. For more recent advanced application of SFA in MFI studies, mention can be made of Hartarska et al. (2014), who employed "true random effect", proposed by Greene (2005), along with BC models of SFA, for panel data of 266 MFIs from over 50 countries. In addition, Bos and Millone (2015) applied the method of "True Fixed Effects" along with BC stochastic frontier to compare the social and financial efficiency of 1146 MFIs between 2003 and 2010.

However, non-parametric frontier method, i.e. DEA, is favoured as there is a lack of access to price information. The difference between DEA and SFA is basically in the way that the efficient frontier is specified, and in the distributive assumptions imposed on the random error and inefficiency (Gregoire & Tuya, 2006). Furthermore, DEA enables researchers to handle multiple variables and variable return to scale. In addition, for DEA there is no restricting assumption about data distribution or cost/production function (Ruggiero, 2005). More importantly, there is a growing effort of scholars in improving DEA to capture a more holistic evaluation of performance. Furthermore, many of the previous deficiencies of DEA, such as

restriction for an unbalanced panel, are overcome by advanced methods such as window DEA or DEA-based Malmquist Index.

To review the microfinance studies with application of DEA, the present study divides the literature into two strands, of conventional DEA studies, and advanced methods such as window DEA, network DEA and DEA-based Malmquist Index.

In general, DEA models can be applied as two sets of options in terms of orientation and return to scale (Thanassoulis, 2001). The return-to-scale difference in the model depends on the technology and scale of production. This means that we assume that the entities are working either in constant or variable return to scale (Thanassoulis, 2001). For microfinance studies, the input-oriented type is mainly employed when there is an ability to control inputs such as assets and labour, while the output orientation shall be opted when the objective is to maximise the services provided to the underprivileged (Bassem, 2008).

The conventional models of DEA in microfinance have been mostly applied to compare the efficiency measured by CRS (termed as overall technical efficiency) and VRS models (termed as pure technical efficiency). The ratio of overall technical efficiency and pure technical efficiency results in finding the scale efficiency of institutions, which helps researchers to investigate the main source of inefficiency in terms of inappropriate allocation of resources or non-optimal scale of production. Amongst the reviewed studies, 13 out of 24, such as Bassem (2008), Haq et al. (2010) and Usman (2011) assessed the scale efficiency of MFIs using conventional DEA models.

Besides finding scale source of (in) efficiency, conventional DEA is applied by MFI studies. For example, Nghiem et al. (2006) used basic DEA to compare the results of DEA with two other prevalent methods of efficiency measurement, SFA and PLP (Parametric Linear Programming) for consistency comparison. The results suggest that, on average, DEA and PLP gain close results, while this result is different with the result from SFA. Gutierrez-Nieto et al.

(2007) employed CRS DEA models to find the most suitable set of variables for DEA models in microfinance. Later, Gutiérrez-Nieto et al. (2009) applied DEA with the most suitable variable selection to evaluate social efficiency. Piot-Lepetit and Nzongang (2014) used multi-DEA to examine the relationship between the sustainability and social outreach of MFIs. Their study identified best practices for which no trade-off exists. Widiarto and Emrouznejad (2015) applied CRS and VRS models to assess the overall performance of Islamic MFIs against best practice global frontiers, regional frontiers, and Islamic frontiers. Lebovics et al. (2016) examined the trade-off between financial and social efficiency of semi-formal and non-state, formal MFIs in Vietnam.

According to Abdelkader et al. (2014), the application of conventional DEA makes the study sensitive to the sampling variations of the frontier. Therefore, recent studies attempted to overcome this deficiency by applying more advanced methods. Wijesiri et al. (2015) applied a two-stage, double-bootstrap DEA, by which advanced DEA is applied in the first stage to separately measure financial and social types of efficiency, and thereby examined the performance of 20 Kenyan MFIs over the years 2009-2012. The supremacy of this study's method, bootstrapping, is to overcome an inherent bias of conventional DEA model in considering measurement error.

The second strand of advancement in non-parametric method of efficiency measurement is the application of the DEA-based Malmquist Index, which equips the scholar for measuring efficiency, its dynamics and scale, and technological and technical efficiency sources of performance growth.

The first microfinance study that applied Malmquist Index is Gebremichael and Rani (2012), which evaluated the time-series efficiency of 19 Ethiopian MFIs. The study investigated the changes in total factor productivity, with decomposition into technology change, technical change, pure technical change, and scale efficiency change. Likewise, Tahir and Tahrim (2015)

and Bassem (2014) measured and decomposed the Malmquist Index of 13 Cambodian and 33 MENA region MFIs, respectively. Musa et al. (2012) also applied this method to assess the impacts of investment in information and communication technology (ICT) on performance and growth of microfinance institutions in Uganda, in terms of improving productivity and reducing business costs.

More recently, the application of the Malmquist Index in microfinance is elaborated by Wijesiri and Meoli (2015) through application of the bootstrapping procedure, and by Wijesiri (2016), through the Meta-frontier Malmquist Luenberger Productivity Index (MMLPI), by involving involve undesirable outputs into the model.

The former study overcame sampling bias by examining the statistical significance of the change in Malmquist Index and the components, through a bootstrap approach. The latter applied MMLPI, which is a combination of Malmquist Luenberger Productivity Index, developed by Chung, Färe, and Grosskopf (1997), and meta-frontier DEA, proposed by O'Donnell, Rao, and Battese (2008), to involve undesirable outputs, considering the heterogeneity in MFIs' technology (structure).

In general, the improvement of the reviewed DEA articles is summarised into five threads. Non-conventional DEA studies: 1) compared institutions with variable return to scale; 2) considered time-series analysis in evaluation of efficiency dynamism; 3) overcame sample bias; 4) specified the best selection of input and output sets; and 5) incorporated undesirable variables. The last two strands of improvement indicate the importance of variable selection in the evolution of microfinance performance, which is discussed in detail next.

2.2.2.2. What variables have been used in DEA studies?

One of the reasons for methodological contradictions involves is the debate about variables. More precisely, there are three approaches based on which microfinance studies select the variables: production, intermediation, and asset approaches (Bassem, 2014). This disparity has

caused the difference in selection of input and output sets for the financial performance aspect. In the production approach, the financial sector is using the two main inputs of employees, capital expenditures (asset) and operating cost, to produce loans and other financial services (e.g. savings, insurance) and, more importantly, deposits for the clients (Kipesha, 2013). Deposit is, therefore, an output because of the value added, including safekeeping, liquidity, and additional services to the account holders (Benston, Hanweck, & Humphrey, 1982).

The intermediation approach refers to the match making of deposits and loans. Hence, deposit is considered as input in this approach, while it is an output in the production approach (Hermes et al., 2011). Under intermediation efficiency, microfinance institutions are considered as intermediary institutions, which collect funds from economic units with excess resources (savers) and channel them to economic units with a deficit (borrowers), hence transferring the purchasing power from surplus units to deficit units in the society (Kipesha, 2013). Lastly, as financial institutions want to maximise loans to their clients, the market value of the total asset is considered one of the main outputs under the asset approach. Although the value of assets acts as output in this approach, loans/credit is the most important financial service that MFIs provide to their customers (Hermes et al., 2011).

According to Mia (2014), the intermediation approach is more applicable in the financial literature, as it measures the efficiency to which deposits and loans are intermediated with savers and borrowers. Nonetheless, many microfinance studies have applied only the production approach, as it is commonly considered that most MFIs do not mobilise funds in terms of deposits and use commercial funds in terms of debts, which has resulted in the dominance of a production approach (Bassem, 2008; Mia & Chandran, 2016; Segun & Anjugam, 2013; Usman, 2011). According to Hunter and Timme (1995), the input or output role of deposits has an enormous impact on the efficiency results obtained. Amongst the

reviewed literature, only two studies, Kipesha (2013) and Segun and Anjugam (2013), have considered deposits in their performance measurements.

Holod and Lewis (2011) solved the dilemma of deposits using the network DEA model by considering deposit as an intermediate product that is an output from the first stage of the bank production process, and as an input in the second stage. For microfinance studies, the deposit dilemma has been resolved by Piot-Lepetit and Nzongang (2014), who applied the two-stage process based on Zhu and Ding (2000). The first stage transforms inputs to deposits based on the production approach. In the second stage, the deposits are used as inputs to provide loans and other financial revenues in accordance with the intermediation approach.

In addition to deposit, the improvement in considering undesirable variables determines another strand of evolution in the literature. Non-performing loans, considered as undesirable outputs, were taken into consideration first by Wijesiri (2016) through MLPI. In the banking literature, Barros, Managi, and Matousek (2012) applied the same undesirable variable to network DEA.

Other than deposit and non-performing loans, the selection of inputs and outputs has a relative consensus and relies on past studies. Yaron's framework of outreach and sustainability (Yaron, Benjamin, & Charitonenko, 1998) determines the most frequent set of indicators. In the present study, we provide a summary of the most frequently applied inputs and financial indicators, as presented in Tables 9 and 10, followed by a discussion on various social performance indicators.

Table 9 Frequently-applied inputs in MFI-DEA studies

Input	Studies Applied
Operating expenses	(Abdelkader et al., 2014; Annim, 2012; Bassem, 2008; Gebremichael & Rani, 2012; Gutierrez-Nieto et al., 2007; Gutiérrez-Nieto et al., 2009; Haq et al., 2010; Hermes & Lensink, 2007; Hermes et al., 2009; Kabir & Benito, 2009; Kablan, 2012; Kipesha, 2012; Lebovics, Hermes, & Hudon, 2014; Masood & Ahmad, 2010; Singh et al., 2014; Tahir & Tahrim, 2013, 2015; Usman, 2011; Widiarto & Emrouznejad, 2015; Wijesiri & Meoli, 2015)
Total asset	(Abdelkader et al., 2014; Ahmad et al., 2014; Annim, 2012; Bassem, 2008; Gutierrez-Nieto et al., 2007; Gutiérrez-Nieto et al., 2009; Haq et al., 2010; Hermes et al., 2009; Kabir & Benito, 2009; Masood & Ahmad, 2010; Tahir & Tahrim, 2013, 2015; Usman, 2011; Widiarto & Emrouznejad, 2015; Wijesiri & Meoli, 2015)
Personnel (in form of staff numbers or labour cost)	(Abdelkader et al., 2014; Ahmad et al., 2014; Annim, 2012; Bassem, 2008; Bassem, 2014; Gebremichael & Rani, 2012; Gutierrez-Nieto et al., 2007; Gutiérrez-Nieto et al., 2009; Haq et al., 2010; Hermes & Lensink, 2007; Hermes et al., 2009; Kabir & Benito, 2009; Kablan et al., 2014; Kipesha, 2012; Lebovics et al., 2014; Masood & Ahmad, 2010; Mia & Chandran, 2016; Singh et al., 2014; Usman, 2011; Widiarto & Emrouznejad, 2015; Wijesiri & Meoli, 2015)/ (Kebede & Berhanu, 2012; Nghiem et al., 2006; Piot-Lepetit & Nzongang, 2014; Segun & Anjugam, 2013)

In general, as Piot-Lepetit and Nzongang (2014) summarised, an MFI input can be broken down into personnel (cost) and the other inputs such as financial capital (equities), material capital (assets) and other expenses – financial and operating costs.

Table 10 Frequently-applied financial outputs in MFI DEA studies

Output	Studies Applied
Financial revenue/ ROA/ ROE	(Abdelkader et al., 2014; Ahmad et al., 2014; Annim, 2012; Bassem, 2008; Gutierrez-Nieto et al., 2007; Gutiérrez-Nieto et al., 2009; Haq et al., 2010; Hermes & Lensink, 2007; Hermes et al., 2009; Kabir & Benito, 2009; Lebovics et al., 2014; Masood & Ahmad, 2010; Usman, 2011; Widiarto & Emrouznejad, 2015; Wijesiri & Meoli, 2015)
Interest and fee income	(Bassem, 2014; Gebremichael & Rani, 2012; Gutierrez-Nieto et al., 2007; Singh et al., 2014)
Operational self-sufficiency/ Financial self-sufficiency	(Abdelkader et al., 2014; Ahlin et al., 2011; Ahmad et al., 2014; Annim, 2012; Jayamaha, 2012; Kabir & Benito, 2009; Lebovics et al., 2016; Mia & Chandran, 2016; Piot-Lepetit & Nzongang, 2014; Postelnicu & Hermes, 2015; Yaron & Manos, 2007, 2010)

As Table 10 presents, most of the studies used operational/financial self-sufficiency and financial revenue, in terms of interest income, return on asset, and return on equity, as proxies of financial performance.

Unlike financial variables, social indicators lack consensus amongst microfinance studies, which is due to the lack of a universal social indicator coordinating with world-level study (Allet, 2012). For microfinance, social efficiency indicates the ability of the MFI to manage welfare policy based on which MFIs impact the society, especially women and the poor, and mainly incorporates two dimensions of outreach (depth and breadth) (Stauffenberg, Jansson,

Kenyon, & Barluenga-Badiola, 2003). The former specifies the capacity of projects to tackle the poverty of the poorest; and the latter measures the amplitude of the project (Bassem, 2008). The most common proxy of breadth of outreach is gross loan portfolio, as for example applied by Annim (2012), Bassem (2008), Gutiérrez-Nieto et al. (2009) and Widiarto and Emrouznejad (2015). In addition, some studies as Ahmad et al. (2014), Bassem (2008) and Lebovics et al. (2014) applied the number of female borrowers to measure the breadth of outreach. Also, many studies such as Bassem (2014); Gebremichael and Rani (2012) and Singh et al. (2014) applied the number of loans outstanding as the social outreach breadth. Kablan et al. (2014), Nghiem et al. (2006), Tahir and Tahrim (2013, 2015), Widiarto and Emrouznejad (2015) and Wijesiri and Meoli (2015) applied the number of active borrowers to gauge outreach width.

Depth of outreach, on the other hand, was mostly measured by three indicators suggested by Lapenu and Zeller (2002): percentage of females within the borrowers, the average amount of loans, and the average amount of the deposits. Among the reviewed studies, average loan per borrower was applied by Gutiérrez-Nieto et al. (2009), Hermes et al. (2011), Kablan et al. (2014), Lebovics et al. (2014) and Segun and Anjugam (2013). Lebovics et al. (2014) measured the depth of outreach considering per capita income of the country, by using the average loan balance divided by GNI per capita. There are also some innovative indicators, such as the benefit to the poorest by Abdelkader et al. (2014), or the poverty reach index using the number of depositors by Gutiérrez-Nieto et al. (2009) and Lebovics et al. (2014).

2.2.2.3. State of the type and scope of complementary methods

Most of the reviewed studies have carried out performance evaluation along with a supplementary analysis to meet in-depth objectives such as specifying the correct input and output sets or discovering efficiency determinants. Gutierrez-Nieto et al. (2007) aimed to select the most appropriate input and output set for efficiency evaluation of MFI and put efficiency scores of the DEA model under various selections of variables into multivariate (pro-fit)

analysis. This signifies that the choice of inputs and outputs as well as the specifications of the DEA model have a profound effect on the efficiency score. Furthermore, Gutierrez-Nieto et al. (2007) found that no institution is efficient under all specifications. The second method applied by this work, pro-fit model, is also applied in Serrano-Cinca, Fuertes-Callén, and Mar-Molinero (2005) and Serrano-Cinca, MarMoliero, and Chaparro (2004).

Moreover, examining the factors that impact the efficiency has been the complementary purpose of most of the reviewed studies. Widiarto and Emrouznejad (2015) applied non-parametric post-DEA analysis, including the Kruskal Wallis test proposed by Kruskal and Wallis (1952), and post-hoc Jonckheeree Terpstra, developed by Jonckheere (1954), to test the effect of different schemes on Islamic MFIs' efficiency. In addition, a large number of prior studies, such as Kablan et al. (2014), Nghiem et al. (2006) and Strøm et al. (2014) measured the impact of different efficiency determinants through regression analysis, especially Tobit regression. This is because the efficiency score gained from the DEA model is limited, between 0 and 1 (or 0% and 100%), and Tobit regression results in more accurate analysis (Nghiem et al., 2006). However, DEA scores used in the second stage are biased and serially correlated, which makes the conventional regressions, including Tobit, less reliable (Wijesiri et al., 2015). Therefore, a few suggestions have been made by scholars, such as non-parametric post-DEA analysis, including Kruskal-Wallis test, Jonckheeree Terpstra, by Widiarto and Emrouznejad (2015), and biased-corrected regression by Wijesiri et al. (2015).

2.3. Concluding remarks and directions for future research

The results of the above two strands of literature review indicates several research gaps and directions for future studies. Grounded upon the discovered gaps in the literature, this empirical study attempts to conduct an empirical analysis in order to enrich the literature through several contributions. First and the foremost, studying the dynamics of performance is a recent topic which that is insufficiently addressed in the MFI literature. In this chapter, this need is met

through the application of the Malmquist Index, which also contributes to the frontier analysis of MFIs. More importantly, the chapter provides solutions to deal with unbalanced data for dynamic studies. Furthermore, the variables selected in this empirical study address the literature gaps in environmental performance and quality of social outreach. In doing so, this study applies an unbalance panel of 53 MFIs across three major emerging countries for the years 2009-2015 (214 observations).

3. CHAPTER THREE - METHOD AND MEASUREMENTS

Productivity dynamics of economic units have been measured by three methods: the Tornquist, Fisher, and the Malmquist Index (MI) methods (Bassem, 2014). MI, proposed by Malmquist (1953), is considered superior to the other two as it enables the researcher to delve into the source of productivity change in terms of efficiency change or technological advance (Grifell-Tatje & Lovell, 1996).

3.1. Malmquist Index for unbalanced panels

The present study opted to perform panel analysis to measure performance using the method of Malmquist Index for an unbalanced panel of 214 observations. Malmquist Index can be used for unbalanced panel data, as the seminal article by Färe, Grosskopf, Lindgren, and Roos (1994) clearly state that MI can be applied for an unbalanced panel, but the index is not defined for missing values. However, some studies such as Hollingsworth and Wildman (2003) claim that unbalanced panel cannot be applied for DEA-based MI. Nonetheless, Kerstens and Woestyne (2014) mention that the main reason for disagreement between some previous studies about the use of unbalance data in MI is due to software inabilities, such as DEAP by Coelli (1996), and not the nature of DEA-based MI. They also claim that MI can be computed for an unbalanced panel provided that the correct computation is applied. In the present study, we employ MAXDEA by Gang and Hua (2009), as this is able to cope with an unbalanced panel by considering unavailable data as missing. MaxDEA was also applied by Paleckova (2015) and Paleckova (2017) for an unbalanced panel.

3.2. Treatment of unbalanced panel

In the present study, we treat the unbalanced panel by considering that, if values for some MFIs in one or more periods are missing, the Malmquist indices for the corresponding MFI are not

computed, but the Malmquist Indices for the available periods will be calculated. This means that each MFI is benchmarked against the frontier that is illustrated for the available period.

However, before running MI, to ensure that the result will not be drifted by missing values, the present study followed Serneels and Verdonck (2008) and applied a two-stage filtering process to remove bad data from the original sample (56 MFIs that constitute 249 observations).

In the first stage, we detected and pair-wise deleted the outliers using Excel Boxplot. This is due to the different behaviour of outliers with other observations in a dataset. Many studies have detected and removed outliers to improve the accuracy of estimation (Acuna & Rodriguez, 2004). To find outliers, we apply Boxplot that visually summarises data to show the spread and symmetry of data distribution by using median, quartiles, and lower and upper bounds of the data (Williamson, Parker, & Kendrick, 1989). A large number of studies, such as Frigge, Hoaglin, and Iglewicz (1989), Potter, Hagen, Kerren, and Dannenmann (2006) and Williamson et al. (1989) have applied and recommended the application of boxplots to detect outliers. The results of the Boxplot, as shown in Appendix B, illustrate several outliers above the upper bound of two inputs. Consequently, after outlier deletion, the remaining data is 214 observations of 53 MFIs from 2009 to 2015.

In the second stage, we apply Little's MCAR test, proposed by Little and Rubin (1989), to ensure that missing values have no dependability on any of the variables, and hence that there is no interference with result accuracy. This test has popularity in the literature (Schlomer, Bauman, & Card, 2010); and is conducted using SPSS. The procedure of the MCAR test, as shown in Appendix C, results in a Chi-Square = .084, DF = 1, Sig. = .773. This indicates that missing data is completely at random and that there is no systematic relationship between missing values and other variables. The results of the MCAR test now assures data credibility, and indicates that the unbalanced panel of this study can be applied in the MI.

3.3. Malmquist Index

We applied DEA-based Malmquist, which is an extension of the Malmquist model that measures efficiency of each period by Data Envelopment Analysis (DEA). DEA-based models are, in particular, appropriate for non-government institutions whose main objective is not profit (Charnes, Cooper, & Rhodes, 1978). Moreover, as a non-parametric method, DEA is suitable in handling multiple inputs and outputs, without being restricted in specifying production or cost function, since the model is based on frontier and not central tendencies (Grifell-Tatje & Lovell, 1996). Moreover, the result is understandable, and provides solutions for efficiency improvement, which is favoured by managers and decision makers (Thanassoulis, 2001)

Following Färe et al. (1994), the Malmquist Productivity Index is based on input/ output distance function, defined, respectively, by radial scaling of input and output.

If $X^t \in R^n$ and $Y^t \in R^m$ are input and output vectors:

Then, the production technology of time T is:

$$S^t = \{(X^t, Y^t) | X^t can\ produce\ Y^t\}$$

And, the distance function of time T is defined as:

$$D_0^t(X^t, Y^t) = \inf\{\theta | (X^t, Y^t/\theta) \in S^t\}$$

Similarly, the output distance function of time t+1 is:

$$D_0^{t+1}(X^{t+1}, Y^{t+1}) = \inf\{\theta | (X^{t+1}, Y^{t+1}/\theta) \in S^{t+1}\}$$

Now, we define a new distance function as:

$$D_0^t(X^{t+1}, Y^{t+1}) = \inf\{\theta | (X^{t+1}, Y^{t+1}/\theta) \in S^t\}$$

which measures the maximal proportional change in output required to make (X^{t+1}, Y^{t+1}) feasible in relation to technology at time T. If we define a similar distance function to capture maximal proportional change in output, considering the technology at time T+1:

Therefore, the Malmquist index is:

$$M^t{}_0(X^{t+1}, Y^{t+1}, X^t, Y^t) = \underbrace{\left[\frac{d_0^{t+1}(X^{t+1}, Y^{t+1})}{d_0^{t+1}(X^t, Y^t)}\right]}_{A} \times \underbrace{\left[\frac{d_0^t(X^{t+1}, Y^{t+1})}{d_0^{t+1}(X^{t+1}, Y^{t+1})} \times \frac{d_0^t(X^t, Y^t)}{d_0^{t+1}(X^t, Y^t)}\right]^{1/2}}_{B}$$

This index is a decomposition of two sources of change in productivity:

The term "A", which represents the change in technical efficiency between time t and t + 1. "A" moves towards the production frontier when the ratio is greater than one; while, if it shifts away from the production frontier, the ratio will be less than 1. In the case of stagnation, "A" would be 1.

The term "B", which indicates the change in technology (technological progress) between the two periods of t and t + 1. Similar indication of values of less, greater and equal to 1, is the case for "B".

The term A can be further broken down into the change of pure technical efficiency and scale efficiency, in such a way that:

Efficiency Change = Scale Efficiency Change × Pure Technical Efficiency Change × Technological Change

$$= \frac{\text{result from VRS efficiency change}}{\text{result from CRS efficiency change}} \times \text{result from CRS efficiency change} \times \text{Technological Change}$$

3.4. Selection of input and output variables

The inputs and outputs in the present study fall into two strands. The first strand is the inputs/outputs that are selected based on previous studies. In the second strand, we introduce two new variables in order to overcome two gaps in the literature of social and environmental performance. According to Jansson, Stauffenberg, Kenyon, and Barluenga-Badiola (2003), the efficiency/productivity is a measure by which an MFI's application of resources, such as assets, to produce social and financial outputs is gauged. Therefore, a proper specification of inputs and outputs is an obligation for accurate efficiency studies.

Table 11 provides the definitions of inputs and outputs. The two inputs in this study are total assets and number of employees, similar to Bassem (2008) and Gutiérrez-Nieto, Serrano-

Cinca, and Molinero (2007, 2009). In addition, two of the financial outputs and two social outputs are selected followed by prior studies. Return On Asset (ROA) as applied by Bassem (2008) and Gutiérrez-Nieto et al. (2007, 2009) and Operational Self-Sufficiency (OSS) as employed by Ahmad, Akram, and Abdi (2014) are the two financial outputs. Depth and breadth of outreach are similarly selected based on prior studies by using average loan size per borrower per capita as the measure of depth of outreach (DEPTH), as in Postelnicu and Hermes (2015) and number of active borrowers (NAB) as the measure of breadth of outreach, as in Widiarto and Emrouznejad (2015) and Wijesiri and Meoli (2015).

Table 11 Definitions of inputs and outputs

		Definition
Input		
Total asset		Includes all asset accounts, net of all contra-asset accounts, such as the loan-loss allowance and accumulated depreciation.
Number of personnel		The number of individuals who are actively employed by an MFI. Includes contract employees or advisors who dedicate most of their time to the MFI, even if they are not on the MFI's roster of employees.
Output		
Social output	NAB	The number of current borrowers, that is the number of individuals that currently have an outstanding loan balance with the MFI or are responsible for repaying any portion of the gross loan portfolio.
	DEPTH	As proposed by Gutiérrez-Nieto et al. (2009), average loan size per borrower divided by GNI per capita.
	Ratio of quality of outreach dummies	Ratio of thirteen dummies: if yes is 1, ratio indicates the dummies, each representing one aspect of quality of outreach.
Financial output	Return on asset	Net income/average assets. Measures how well the MFI uses its total assets to generate returns; since self-reported may not be adjusted for grants and donations
	Operational self sufficiency	Operating revenue/ (financial expense + loan loss provision + operating expense). Measures how well the MFI can cover its costs through operating revenues.
Environmental output		A ratio indicating the dummies of four indicators of environmental activist and policies of MFIs

Source: Gutiérrez-Nieto et al.(2009), Hartarska (2005) and Jansson et al. (2003)

In the second strand of variable selection, two new indicators are here proposed: 1) quality of social output (Quality); and 2) environmental output (ENV). These indicators are built based both on the need identified in the literature and the availability of data in MIX. Outreach quality or impact is defined as the net benefit to clients, including indirect benefits during the period (Zeller, Lapenu, & Greeley, 2003).

The QUALITY is based on twelve social goals of MFIs, as follows: 1) improvement of adult education; 2) children's schooling; 3) health improvement; 4) women's empowerment; 5) access to water and sanitation; 6) housing; 7) increased access to financial services; 8) poverty reduction; 9) employment generation; 10) development of start-up enterprises; 11) health improvement; and 12) growth of existing businesses. The ratio of QUALITY indicates the number of social goals that each MFI achieves in such a way that, for an MFI that meets six of the twelve social goals in the corresponding year, the indicator of quality is 50%.

As a recent concept in MFIs, several difficulties were faced in measuring environmental outputs. The main problem in assessing the environmental performance of MFIs is the lack of a consistent and unified measurement (Allet, 2012). This is, in particular, more difficult for microfinance, since this industry has indirect and hidden environmental impacts compared to the manufacturing sector with its measurable ecological footprint (Allet, 2012). The only available measure of MFIs' environmental responsibility is the index proposed by Allet (2012), the Microfinance Environmental Performance Index (MEPI). However, due to the secondary nature of data in the present study, we must rely only on available variables in the MIX.

Given the availability of data and the MEPI index, we introduce the ratio of environmental output. This ratio consists of the following four dummies, quantifying the direct and indirect environment impacts of MFIs' activities and loans:

1) The MFI conducts activities related to raising awareness of environmental impacts, including running training sessions and discussions, and displaying posters; 2) the MFI

includes clauses in loan contracts that require clients to enhance environmental practices or reduce environmental risks; 3) the MFI uses specific tools to evaluate the environmental risks of clients' activities; 4) the institution offers specific loans linked to environmentally friendly products and/or practices.

Table 12 reports the descriptive statistics of the inputs and outputs, including the mean, standard deviation (std.dev), and minimum (min) and maximum (max) values, considering all years (2009-2015).

The unit of asset is USD, of personnel and number of active borrowers (NAB) is the number, and other variables are in percentiles. Most of the indicators in this study showed fluctuations in their values; and the study comprises small to large MFIs in terms of the number of personnel or asset value. The large standard deviation, along with large mean, for OSS, ROA, NAB, Personnel and Asset, indicates that data is spread out around a large number, which is consistent with having variable MFI size.

Table 12 Calculated descriptive statistics of inputs and outputs (average of all years)

	Asset ($)	Personnel	NAB	OSS(%)	ROA(%)	ALS/GNI(%)	Quality (%)	ENV (%)
Mean	4.14E+07	6.30E+02	1.62E+05	1.16E+00	2.50E-02	1.15E-01	5.13E-01	2.46E-01
St.dev	5.07E+07	9.95E+02	1.97E+05	1.75E-01	2.48E-02	4.04E-02	3.02E-01	2.59E-01
Min	5.54E+05	2.80E+01	1.17E+02	6.86E-01	0.00E+00	3.83E-02	0.00E+00	0.00E+00
max	1.06E+08	2.05E+03	2.19E+05	1.64E+00	3.72E-02	2.22E-01	1.00E+00	1.00E+00

3.5. Data

Data of this study are obtained from the MIX (www.themix.org), one of the most common databases used in the MFI literature (Wijesiri, Viganò, & Meoli, 2015). To minimise the likely bias of self-reported data, only MFIs were selected that have the highest informational transparency. More precisely, the MIX has a channel through which the informational transparency is ranked, by one to five stars. Furthermore, the MIX labels MFIs with the highest clarity of social report, by the labels of "Social Performance Desk Review (SPDR)" and "Social transparent and responsible". Therefore, in the present study, where possible[1], we select only MFIs with 4 or 5 diamonds. As mentioned, after removing the outliers, the unbalanced panel of 53 MFIs for 7 years of 2009-2015 remains, which implies 214 observations in total.

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[1] Since the number of Chinese MFIs registered in the MIX is very limited compared with Indian and Brazilian MFIs, none of the MFIs in China pass this filtering, and we applied only available data regardless of diamonds.

4. CHAPTER FOUR - RESULTS AND DISCUSSION

This chapter reports on the findings of the empirical analysis. It, firstly, provides a brief overview of MFI statistics over the period of the study. Table 13 represents the yearly descriptive statistics of inputs. The mean values of assets and personnel show the growth of the industry from 2009 to 2015. In addition, the minimum size of MFIs has increased, meaning that the smallest MFIs have expanded or left the industry over time. However, the maximum number of both assets and personnel has decreased between 2009 and 2015, from $424,220,483 in 2009 to $230,118,399 in 2015; and employees reduced from 6,620 in 2009 to 3,473 in 2015. This implies that the largest MFIs in 2009 either reduced their scale or left the market up till 2015.

On the other hand, output statistics, as represented in Table 14, show the overview of financial, social and environmental outputs. ROA and OSS, as the two indicators of financial outputs, show that MFIs improved their financial outputs over time. Social outputs, however, improved in terms of depth of outreach (average loan size per borrower per GNI per capita) and breadth of outreach (number of active borrowers). However, MFIs failed in reaching the expected social goals, from meeting 57% of social goals in 2009 to 40% of social goals in 2015. This means that the quality of outreach decreased over the period of the study.

The ratio of environmental output indicates that, in 2009, on average, MFIs applied 25% of environmentally-responsible policies and management. In 2015 this number had slightly improved, to 29%.

Table 13 Yearly descriptive statistics of inputs

	Year	2009	2010	2011	2012	2013	2014	2015
Asset	**Mean**	65399433	89869161	89809060	75231853	110738286	132290954	118123639
	Min	4627957	701197	636818	553524	567722	679524	16100000
	Max	424220483	698807350	833779632	982599687	1116574525	1012636988	230118399
	st.dev	102828263	171001733	181949813	160550689	214131359	227835243	69707765
Personnel	**Mean**	1142	1579	1583	1144	1275	1299	1709
	Min	29	28	29	28	34	43	48
	Max	6620	11697	16194	11450	13010	9698	3473
	st.dev	1479.66	2801.38	3201.46	2355.35	2355.82	2029.86	1173.47

Table 14 Yearly statistics of outputs

		Year	2009	2010	2011	2012	2013	2014	2015
Financial *Output*	ROA	**Mean**	0.037	0.033	-0.002	0.007	0.024	0.036	0.024
		Min	-0.207	-0.140	-0.635	-0.469	-0.406	-0.115	0.011
		Max	0.250	0.295	0.254	0.218	0.154	0.199	0.033
		st.dev	0.082	0.069	0.146	0.105	0.069	0.044	0.090
	OSS	**Mean**	1.106	1.103	1.033	1.114	1.217	1.273	1.093
		Min	-0.337	-0.219	-0.243	-0.302	0	0.571	0.39
		Max	1.583	1.602	1.627	2.582	2.201	2.708	1.326
		st.dev	0.309	0.302	0.362	0.413	0.386	0.352	0.324
Social *Output*	# of active borrowers	**Mean**	287220	42188	446806	390637	488138	513379	529555
		Min	1518	1446	1582	476	118	117	674
		Max	2301433	4188655	4256719	4433885	5409866	5325244	1010208
		st.dev	496226.24	892539.29	994458.37	943875.02	1073953.26	969371.10	362529.09
	ALB per borrower /	**Mean**	0.141	3.82	3.176	4.562	3.185	4.358	0.571
		Min	0.064	0.056	0.049	0.046	0.038	0.049	0.110
		Max	0.475	129.81	122.34	204.78	152.96	188.22	2.3315

GNI per capita		st.dev	0.083	21.92	19.32	29.842	21.181	27.72	0.84
Ratio of quality of outreach		Mean	57%	58%	42%	47%	48%	43%	40%
		Min	23.08%	0%	0%	0%	0%	0%	31%
		Max	83%	92%	92%	100%	92%	100%	42%
		st.dev	0.181	0.227	0.341	0.303	0.289	0.227	0.049
Environmental Output	Ratio of environment	Mean	25.00%	26%	29%	27%	29%	25%	29%
		Min	0.00%	0%	0%	0%	0%	0%	0%
		Max	75%	100%	100%	100%	100%	100%	50%
		st.dev	0.226	0.283	0.295	0.292	0.304	0.260	0.160

The statistics of the inputs and outputs and their changes can provide only a brief overview of MFIs' output over the period of the study. However, productivity (as a proxy of performance) has a different meaning and measurement to that of output. Therefore, finding the performance dynamics of MFIs requires further investigation of the changes in MFIs' production function and their distance from best practice. This is quantified by the Malmquist Index and its decomposition. In the following, we categorise the MI analysis and its decomposition into three strands of overall productivity, each dimension (financial, social and environmental) productivity and the source of productivity change.

4.1. Overall productivity (combining two inputs and six outputs)

Productivity, in its simplest form, is defined as the ratio of output over input; and therefore, in frontier techniques, it is optimised by maximising outputs or minimising inputs (Charnes, Cooper, & Rhodes, 1978). The MI technique used in the present study measured productivity by controlling inputs and maximising outputs.

The overall results of the Malmquist Index and its decomposition are presented in Table 15, which are gained from two inputs and all the six financial, social and environmental outputs. The average Malmquist Index of 1.033 indicates 3.3% growth of total factor productivity; however, MFI performance didn't improve in all years. In the first four periods, the performance of MFIs improved compared to the previous year. However, the MFIs faced deterioration in overall performance (-1.5%) from 2013 to 2014, and a higher decline (-3.3%) from 2014 to 2015. In addition, the highest rate of growth, 6.2%, occurred from 2012 to 2013.

Table 15 Results of Malmquist Index

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	average
SEC	0.800	0.981	1.008	0.970	0.979	1.105	0.974
PTC	0.992	0.971	0.987	1.007	1.002	1.082	1.007
TEC	0.793	0.953	0.995	0.976	0.980	1.195	0.982
TC	1.312	1.151	1.050	1.088	1.004	0.809	1.069
MI	1.040	1.097	1.045	1.062	0.985	0.967	1.033

Source: Authors' calculation

The variation in rates of growth for different periods indicates that, from 2009 to 2015, the overall performance has decreased. As Figure 2 suggests, despite the positive average MI, the performance of MFIs in the three major emerging economies has regressed rather than progressed. Bassem (2014) also found similar behaviour of MFIs in the MENA region over the period of 2007-2011, that, despite the positive average change in productivity, the illustration of growth rates showed productivity decline.
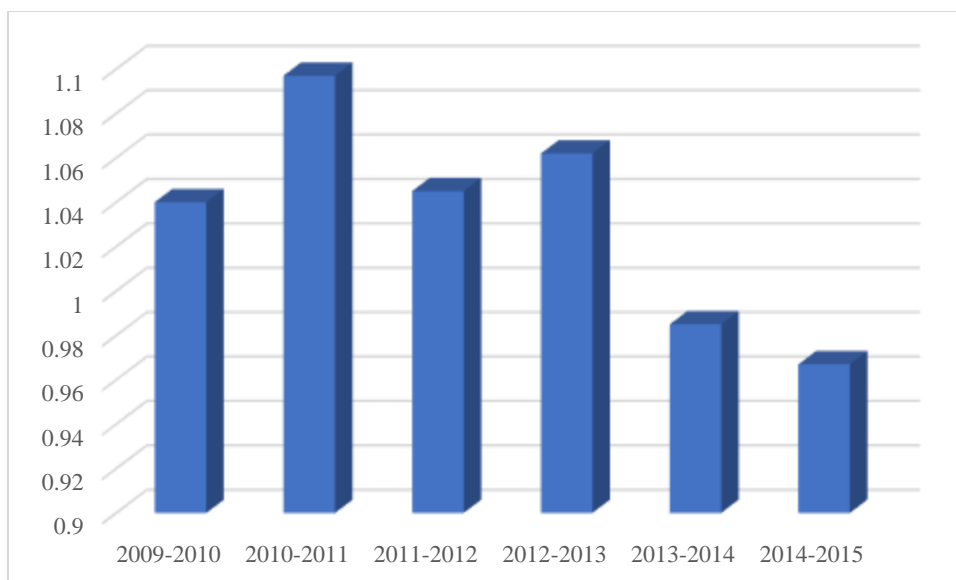

Figure 2 Overview of yearly changes in overall productivity

In addition, it is found that, during 2007-2011, MENA MFIs had 0.5% higher average efficiency than did MFIs in emerging countries. Comparing the similar periods, we see a 5.4%

growth of MENA MFIs from 2009 to 2010, which is higher than productivity growth of MENA in the same period, i.e. 4%. On the other hand, from 2010 to 2011 there is a noticeable improvement of productivity in emerging countries, 9.7%, while over this period MENA MFIs faced a mild productivity reduction, -0.04%.

Furthermore, comparing the result with Wijesiri and Meoli (2015) and Mia and Chandran (2016), we conclude that, for the period of 2009 to 2012, the highest rate of growth is seen in MFIs in emerging countries, compared to Kenyan and Bangladeshi MFIs. During 2009-2012, the present study's MFIs have almost twice as much progress as Kenyan and three times as much as Bangladeshi MFIs (the growth rate is 6.9% for Kenyan MFIs, 4.6% for Bangladeshi MFIs, and 12.3% for the present study's MFIs). However, ignoring the period similarity, almost similar progress in productivity is found over 2007-2012 for MFIs in Bangladesh and in emerging countries' MFIs during 2009-2015.

4.2. Financial, social and environmental productivity

The separate evaluations of the dynamics of financial, social and environmental productivity show that, on average, the financial and environmental productivity of MFIs have, yearly, progressed by 28.2%, and 4.4%, respectively. The social dimension, however, has had an average of 0.7% decline for each year. The overview of yearly change in each dimension of performance is, furthermore, outlined in Figures 3, 4 and 5.

Table 16 Financial, social and environmental productivity dynamics

|	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	average
Financial							
SEC	0.946	1.397	0.957	0.800	1.637	1.957	1.282
PTC	1.057	0.960	1.003	0.991	1.123	1.093	1.038
TEC	1.001	1.341	0.960	0.793	1.838	2.139	1.345
TC	0.959	0.864	1.046	1.341	0.715	0.433	0.893
MI	0.960	1.158	1.005	1.064	1.313	0.927	1.282
Environmental							
SEC	0.544	0.358	1.066	1.158	0.989	1.086	0.867
PTC	0.789	0.548	1.071	0.973	1.353	1.424	1.026
TEC	0.429	1.960	1.142	1.128	1.338	1.546	1.256
TC	1.981	0.792	0.845	0.810	0.797	0.591	0.968
MI	0.851	1.553	0.966	0.914	1.067	0.915	1.044
Social							
SEC	0.811	1.067	1.016	0.924	1.039	1.102	0.993
PTC	0.962	0.958	0.979	1.029	0.987	1.095	1.002
TEC	0.780	1.022	0.994	0.950	1.024	1.206	0.995
TC	1.367	1.063	1.063	1.135	0.993	0.786	1.068
MI	1.067	1.086	1.058	1.078	1.018	0.948	0.995

Source: Authors' calculation
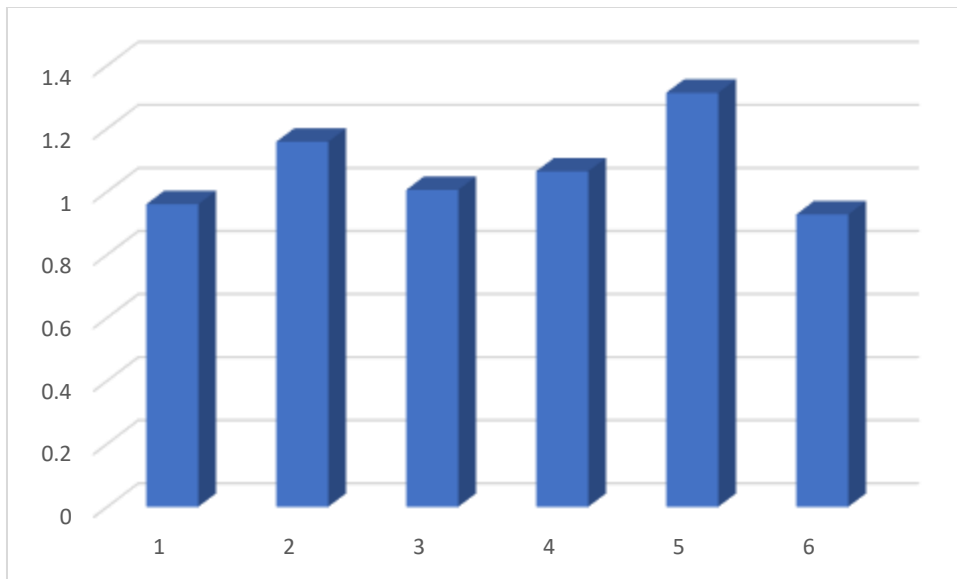
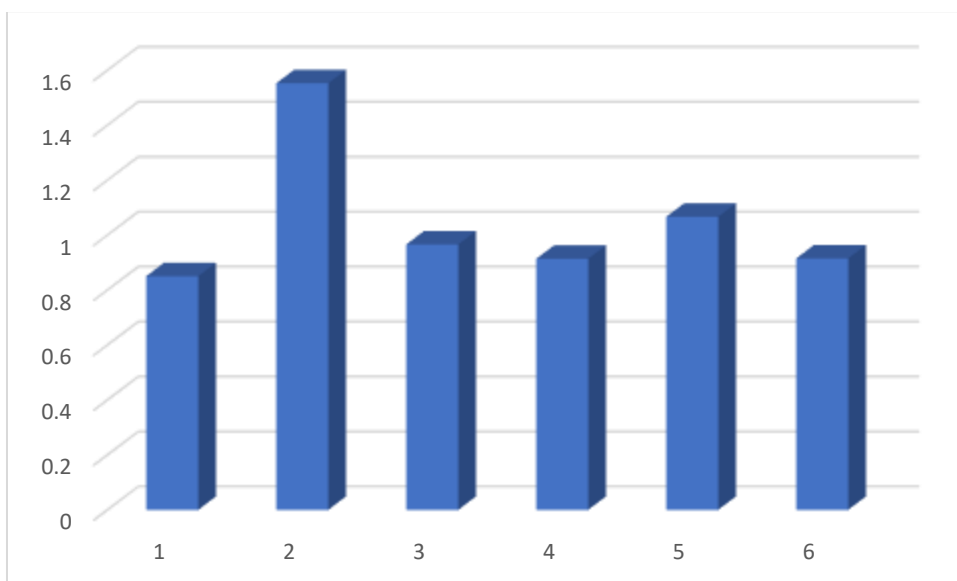Figure 3 Overview of yearly changes in financial productivity

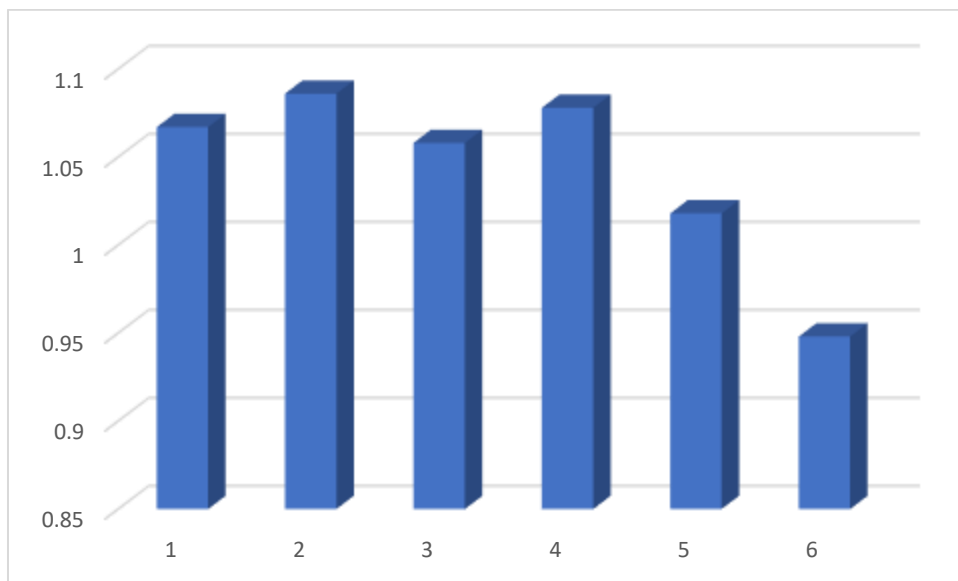Figure 4 Overview of yearly changes in environmental productivity

Figure 5 Overview of yearly changes in social productivity

The change in financial productivity, as shown in Figure 3 has remained steady, while the average MI indicates 28.2% growth. This implies on average the rate of growth remained unchanged, despite the fluctuations. However, the fluctuations led the average growth to show a larger number. Positive change in financial productivity is also seen in Mia and Chandran (2016); however, Mia and Chandran (2016) found higher growth in the social aspect of performance.

Moreover, pair-wise comparison of each period's Malmquist Index for financial and social aspects shows that the signs of financial and social productivity changes are similar, except for the first period. This signifies that, from a dynamic prospective, there is no trade-off between financial and social performance. Similar comparison between social and environmental productivity dynamics suggest that, in different years, changes in MFIs' environmental productivity show different relationships with change in social productivity; while Forcella and Hudon (2016) found a positive relationship between social and environmental efficiency of

European MFIs, at a static level of analysis. Graphical illustration of social productivity changes, as Figure 5 suggests, shows a noticeable decline in social productivity.

In terms of environmental dimension, the result shows moderate growth in the trend of environmental productivity growth, as shown in Figure 4. However, MFIs haven't improved environmental performance in all years. The MFIs' environmental performance faced a 14.9% deterioration in productivity from 2009 to 2010, from 2011-2012 of 3.4%, from 2012-2013 of 8.6%, and from 2014-2015 of 8.5%. Accordingly, the significant improvement of 55.3% in 2011 with respect to 2010, and 6.7% improvement of performance in 2014 compared to 2013, compensated for the productivity declines of other periods

4.3. Sources of productivity change

The decomposition of MI reveals that the growth in average performance of each year is due to technological change (TC) rather than technical efficiency change (TEC). Given the context of microfinance, technological advance refers to incorporating information and communication technology, such as the application of mobile banking, internet and computers in the administration sector, and the use of new technology in loaning methods, new products, and comprehensive savings schemes. These technological improvements shift the production frontier upwards, and allow more output from the same level of inputs or the same level of output from less amount of inputs (Mia & Chandran, 2016).

To investigate the sources of the change in technical efficiency, TEC is decomposed into scale efficiency change (SEC) and pure technical efficiency change (PTC). SEC refers the ability to work on optimal scale; while PTC refers to the ability of the management to avoid wastage of inputs and produce maximum outputs or employ less input for the production of outputs (Bassem, 2014).

The result of MI decomposition for overall productivity shows that on average improvement in technology led to a 6.9% increase in overall productivity from 2009 to 2015. Indeed, as Table 15 suggests, there is a decline in the MFIs' technical efficiency, -1.8%, that in turn has caused reduction in overall performance. More importantly, there is only one period in which MFIs improved their technical efficiency, from 2014 to 2015, while in all other periods technical efficiency declined.

From the frontier prospective, the improvement in technical efficiency means the catching up of DMUs with their own frontier. Therefore, its decline can be interpreted as the failure of MFIs to produce the best combination of outputs, and falling below the frontier (Färe, Grosskopf, Lindgren, & Roos, 1992).

The result of scale efficiency change shows negative growth rate in all periods, except for the period of 2014 to 2015. This trend is exactly similar to the trend of changes in technical efficiency change. This implies that the main reason for change in technical efficiency is change in scale efficiency rather than in pure technical efficiency; which indicates that, to improve performance, MFIs in emerging economies need to optimise their scale rather than improve the management of resources (PTC). In this way, our results contrast with those of Bassem (2014) and Gebremichael and Rani (2012), who found that pure technical efficiency change has a stronger effect on technical change of the MENA and Ethiopian MFIs.

Moreover, we likely oppose Bassem (2014) and Mia and Chandran (2016), who claimed that the three decades of microfinance and "know-how" effect resulted in improvement of technical efficiency. Rather, the present study's results are consistent with those of Wijesiri and Meoli (2015), that technology advancement is the main driver of productivity growth of MFIs. The technology growth of MFI can be due to the penetration of mobile-based transactions, as for Kenya (Wijesiri & Meoli, 2015), or to the application of information technology (IT) in

financial services, which improves the competitive power of MFIs (Kauffman & Riggins, 2012).

The main driver of financial productivity growth is technical efficiency change, which contributes to total factor productivity by 34%; while negative technological advance, of 11.7%, stops financial productivity from reaching its fullest improvement. This may be due to the costs of adopting modern technologies for transactions or upgrading the systems of moneylending. To the best of the author's knowledge, there is no study that has investigated the relationship between technological advance and financial productivity growth of MFIs. Therefore, future studies are needed to unravel the reasons for the negative impact of technological advances on financial productivity.

The decomposition of TEC reveals that scale efficiency change (28.2%) is greater than pure technical efficiency change (3.8%). This indicates that optimising the scale of production has a greater impact on the financial productivity, compared to the pure effect of resource management.

Similarly, technological advance has a negative impact, -3.2%, on the growth of environmental productivity. On the other hand, a high rate of improvement in technical efficiency, 25.6%, has led to a positive rate of growth in the total environmental factor productivity, of 4.4.%. This growth can be, to some extent, due to increasing the importance and awareness of environmental performance, as suggested by Allet and Hudon (2015).

Considering the decomposition of the Malmquist Index, it is found that, except for the period of 2009-2010, the main obstacle in environmental productivity improvement was technological advance, while technical efficiency in most of the periods improved. This indicates that, for the environmental dimension of performance, the "know-how" process of learning by doing, which improves efficiency over time, is a contributing factor. This also, to some extent,

supports Allet (2014), that more mature MFIs have better environmental performance. However, from the pair-wise consideration of each period's Malmquist Index, shows a contrasting finding to that of Allet (2014): i.e. it is found here that more profitability has no relationship with higher environmental performance.

Breaking down the Malmquist Index for social productivity shows that, before 2013, technological advance was the main driver of social productivity growth; while the "know-how" impact on managerial aspect of performance, which attempted to maximize the output by proper allocation of resources impacted this deterioration. After 2013, however, technical efficiency improved, but the technological regression first led to a reduction in rate of growth from 7.8% to 1.8%, and then a negative rate in such a way that, in last period, the productivity change was -5.2%.

5. CHAPTER FIVE - CONCLUSION

This chapter briefly outlines how the research questions have been addressed and what implications the findings have for the theory and practice of MFI performance. Limitations of the research are also presented, as opportunities and suggestive directions for further work in this field, and provide a suggestive list of directions for further work in this field.

5.1. Summary of how research questions have been addressed

This study seeks to address three questions. Question one is: "How has the overall performance of MFI in major emerging economies changed?" Considering productivity as a proxy of performance, results suggest that the yearly overall performance improved by 3.3%, while the rate of productivity growth declined from 2009 to 2015. The second question is: "What is the level of growth in each dimensions of performance in terms of social, financial and environmental performance?" Our findings show that financial and environmental productivity increased over the years of study, while social productivity deteriorated. The third question is: "What is the main driver of performance change in terms of change in the scale of production, technical efficiency and technological advance?" The decomposition of MI into technological advance, pure technical efficiency and scale efficiency reveals that technological advance was the main driver of improvement in social performance, while it hindered MFI from financial and environmental improvement. Rather, efficiency improvement, in terms of both optimising the scale and managing the allocation of resources, helped the MFIs to improve their financial and social performance.

5.2. Limitations and directions for future research

This research, as with any research, has limitations each one of which poses opportunities for future research. Two are noteworthy. Firstly, an uneven and incomplete dataset in the MIX market database limited the scope of the research. Secondly, the lack of sufficient data on MFIs

in Russia hindered a complete investigation into the performance dimensions of MFIs in emerging markets. Considering these limitations, future studies could replicate this study's model using different datasets and a wider range of MFIs from Russia or other similar countries.

5.3. Implications

5.3.1. Theoretical implications

This study makes three original contributions to the literature on the performance measurement of MFIs. Firstly, little had previously been done on the dynamic evaluation of the performance of MFIs. To address this gap, the Malmquist Index was utilized to examine productivity dynamics of MFIs as a proxy of their performance dynamics. Secondly, prior research has underemphasised the environmental dimension of the performance of MFIs. To address this deficiency, one composite indicator of four environmental factors was developed and added to the research model. Finally, data from unbalanced panels are prevalent in the MFI sector. Despite this fact, the literature on the performance of MFIs lacks studies based on unbalanced panels. The present study is among the earliest, perhaps the first, to address this issue.

5.3.2. Practical implications

This study has an important implication for policy making and management of MFIs. Findings of this research reveal that overall productivity has grown steadily but that this has been due mainly to financial and environmental rather than social performance. Hence, managers of MFIs are encouraged to emphasize more on the depth, breadth and quality of outreach. After all, the key goal of MFIs is to eradicate social problems. Therefore, not falling behind in this goal should be a strategic priority for managers of MFIs.

5.4. Concluding remarks

This study has measured the productivity dynamics of MFIs in three major emerging countries, Brazil, India and China. The study comprised 214 observations from an unbalanced longitudinal dataset ranging from 2009 to 2015. The method of Malmquist Index with two tests of outlier and MCAR has been applied and decomposed to discover the source of change in total factor productivity. The present study mainly responds to the future research directions indicated by Allet (2014) and Mia and Chandran (2016) that, respectively, call for researchers to apply more empirical analysis of environmental performance and to study more the dynamics of performance. The findings of the present study lend strong policy support to the sector for MFI policy makers to recognize the main source of decline in efficiency for each of the dimensions of performance. The Malmquist Index shows that overall productivity had a positive average yearly productivity growth of 3.3 %, while further analysis indicated that the trend of productivity change was declining.

Splitting the overall performance into financial, environmental and social performance shows that the financial productivity had the highest rate of growth, followed by environmental productivity. On the other hand, MFIs' social productivity has declined over time.

Malmquist Index decomposition shows that, in overall performance, improvement is mainly driven by technological advance. However, for financial and environmental productivity, technical efficiency improvement is the leading contributor in productivity growth. This is also the case for social productivity change before 2013.

Therefore, we recommend that policy-makers put greater emphasis on the improvement of technical efficiency to strengthen financial and environmental performance. Social performance, however, can improve by introducing modern technology. More importantly, the improvement of technical efficiency should be through scale optimisation for financial output, and management of resource wastage for social and environmental efficiency. Due to the

stronger impact of social and environmental aspects in emerging economies' MFIs, we recommend that decision-makers in these MFIs focus on managing their resources to maximize output and avoid changing their scale.

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APPENDICES

Appendix A: Journals and research domains of systematically reviewed literature

Table 17 Journals and research domains of systematically reviewed literature

Research domain	Journal Title	No	Total	Percent
Development Economics/ Economics	Finance and development	1	32	60%
	World Development (WD)	16		
	Journal of Development Economics (JDE)	3		
	Journal of African Economics (JAFE)	1		
	Applied Economic (AE)	6		
	The Economic Journal (TEJ)	1		
	Journal of Economic Literature (EL)	1		
	American Journal of Agricultural Economics (AJAE)	1		
	Review of Economic and Statistics (RES)	1		
	Social Indicator Research (SIR)	1		
Operational Research/ Management science	Operation Research Society (ORS)	1	8	15%
	OMEGA (OMG)	1		
	European Journal of Operation Research (EJOR)	1		
	Management Studies (MS)	1		
	European Financial Management (EFM)	1		
	Economic Modeling (EM)	3		
Business and finance	International Business Review (IBR)	1	13	25%
	Journal of Financial Service Research (JFSR)	1		

Journal of Business Ethics (JBE)	3		
Journal of Banking and Finance (JB&F)	5		
Emerging Market Review (EMR)	1		
Journal of Retailing and Consumer Services (JRCS)	1		
Journal of business research (JBR)	1		
Total	53	53	100%

Appendix B: The results of Boxplot

Boxplot for Asset

Boxplot for Personnel
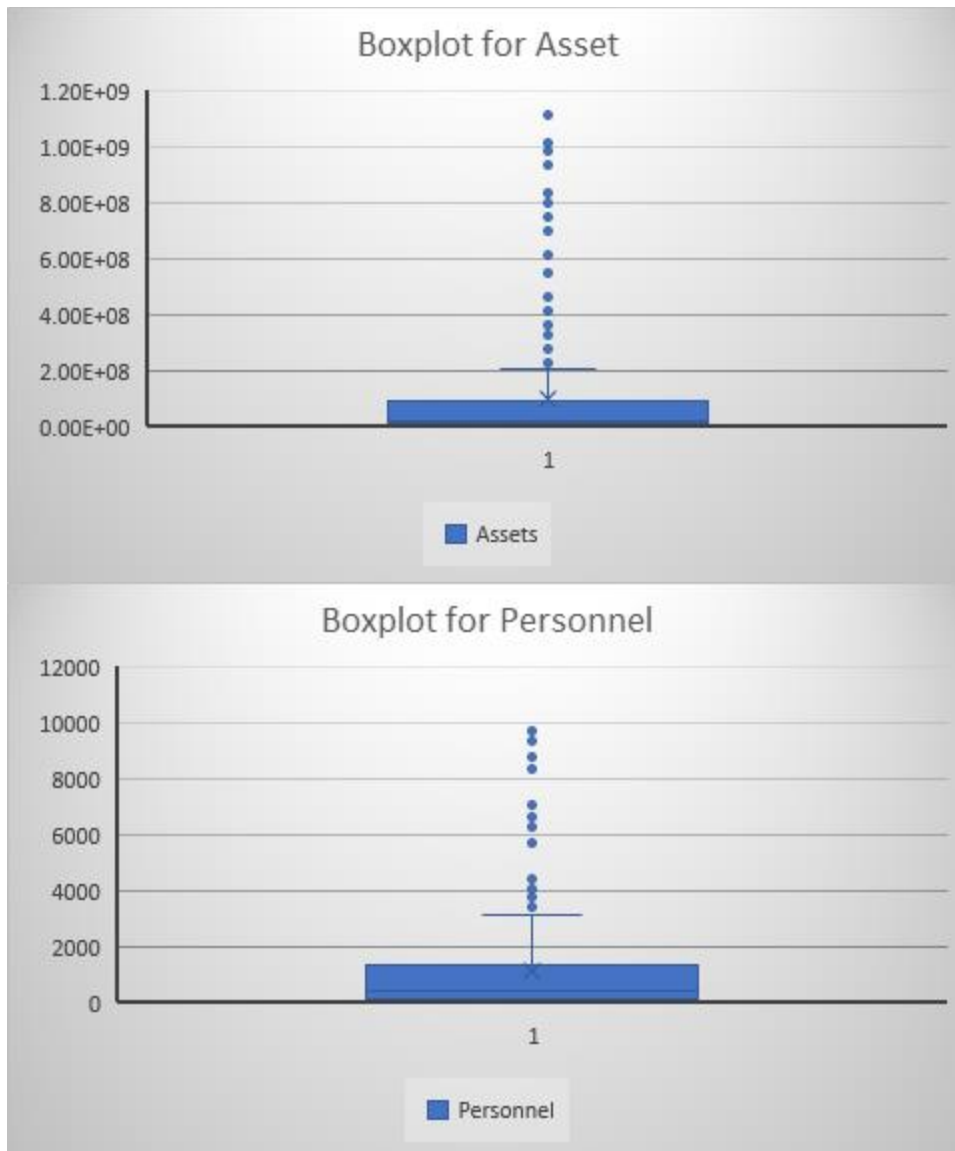
Appendix C: The results of MCAR test

EM Estimated Statistics

EM Means[a]

period	Assets	Personnel	Numberofactiveb orrowers	Percentoffemal eborrowers	AlsoverGNIpcapita	Quality	Environment	Returnonasset s	Operationalselfs ufficiency
2011.990	98473757.90267935 000	1347.747	443043.931	80.5187%	341.331903%	48.1725%	.2681	2.1317%	114.9813%

a. Little's MCAR test: Chi-Square = .084, DF = 1, Sig. = .773

EM Covariances[a]

	1	2	3	4	5	6	7	8	9	10
period	4.0156									
Assets	43491287.8256	34636498919374204.								
Personnel	-75.3492	366264716179.10864	5846440.8343							
Numberofactiveborrowers	128836.1987	143810736823298.12	2130503285.2764	867494618709.9579						
Percentoffemaleborrowers	-8.9535	95241454.20946223	4604.8510	1267036.5717	976.84435%					
AlsoverGNIpcapita	118.7329	-31227757312.256985	-421257.1587	-140372413.6939	-449.33022%	5232180.3790349%				
Quality	-9.5136	231194644.84163165	5457.5664	3200936.1462	8.79881%	8773.6027346%	778.87499%			
Environment	.0008	13450952.406329485	161.8038	46682.5228	0.15103%	-87.4139666%	0.82255%	.07881		
Returnonassets	.3701	-40301292.20959851	-5641.3993	-1524675.3700	-8.97808%	-285.6296903%	-8.70351%	-.20135	81.32007%	
Operationalselfsufficiency	15.1818	1014291431.8045074	-5321.4195	671020.2569	-12.40093%	-2788.0236712%	-53.50411%	-.30734	130.65307%	1425.25913%

EM Correlations[a]

	period	Assets	Personnel	Numberofactiveborrowers	Percentoffemaleborrowers	AlsoverGNIpcapita	Quality	Environment	Returnonassets	Operationalselfsufficiency
period	1									
Assets	.117	1								
Personnel	-.016	.814	1							
Numberofactiveborrowers	.069	.830	.946	1						
Percentoffemaleborrowers	-.143	.016	.061	.044	1					
AlsoverGNIpcapita	.026	-.073	-.076	-.066	-.006	1				
Quality	-.170	.045	.081	.123	.010	.137	1			
Environment	.002	.257	.238	.179	.017	-.136	.105	1		
Returnonassets	.020	-.024	-.259	-.182	-.032	-.014	-.035	-.080	1	
Operationalselfsufficiency	.201	.144	-.058	.019	-.011	-.032	-.051	-.029	.384	1

a. Little's MCAR test: Chi-Square = .084, DF = 1, Sig. = .773