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Microfinance efficiency trade-offs and complementarities

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Abstract

This study argues that patterns, trends and drivers of the efficiency of microfinance institutions (MFIs) depend on the scope of financial sustainability measures and on MFIs' inclination to either of the dual objectives of financial systems and outreach. A balanced panel data of 164 MFIs for the period 2004-08 is extracted from the MIX website for the study's use. Both parametric and non-parametric efficiency estimation techniques are used. Contrary to a trade-off between financial efficiency and outreach, the latter tends to have a positive link with social efficiency. Negative effects of bureaucracies in property registration and lack of credit information on social efficiency are also observed.

Keywords: Microfinance; financial efficiency; social efficiency; sustainability; outreach

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Introduction

Recent evidence of diminishing loan portfolio quality has heightened the drive to investigate the efficiency of microfinance institutions. Anecdotally, this has been attributed to the adverse effects of the global financial turmoil. Chen et al. (2010) show that in the latter part of 2008 and early 2009 credit quality and growth of microfinance institutions (MFIs) dropped in comparison to the period between 2005 and 2007. In addition, growing and unflinching interest from commercial banks and private capital investors in microfinance, coupled with high cost of service delivery, generates concern regarding the efficiency and financial sustainability of MFIs. The conceptual variation between efficiency and financial sustainability is imperative.

Based on the financial and poverty reduction goals of MFIs, this study measures efficiency based on a multiple input/output framework and assesses estimates in the context of both pure technical[1] and scale[2] efficiency. We argue that: (1) patterns and trends of MFIs efficiency vary depending on the assumption underlying returns to scale (pure technical and scale); and (2) MFIs' inclination to either of the dual objectives (financial sustainability or poverty reduction), operational strategies and the external environment affects their efficiency. Specifically, hypotheses tested in this paper are: (1) operational sustainability complements efficiency (financial and social); (2) MFIs targeting women trade off their financial efficiency with social efficiency; and (3) external environment (credit information, property rights and financial development) has a significant positive effect on MFIs' social efficiency, while financial development impacts only on financial efficiency.

In this paper, we explore variants of efficiency measures (pure technical and scale efficiencies) in the context of narrow and broad perspectives of financial performance and breadth of outreach (targeting women). We therefore examine patterns and trends of efficiency from six perspectives. The motivation is premised on the different components of financial sustainability and outreach (Appendix II). For the sake of brevity, we restrict the investigation of efficiency drivers to pure technical efficiency. As a result, three perspectives of pure technical efficiency (narrow and broad financial performance, and breadth of outreach) are examined for the hypotheses.

This study's significance is dual. First, from a management policy perspective, the calculation of relative efficiency scores will provide a benchmarking analysis to stimulate efficiency of MFIs towards the direction of best performing institutions. Secondly, estimating the significance and coefficients of efficiency drivers will generate public

[1] Pure technical efficiency is based on the MFIs' managerial ability to implement production plans and processes accurately.
[2] Scale efficiency focuses on the overall growth and planning of the MFI. The board and/or owner of the MFI are responsible for improving scale efficiency.

policy discourse. This in our opinion is a crucial step in determining microfinance resilience to shocks.

Based on reviewed microfinance economic efficiency empirical studies (Hermes et al. (2009); Haq et al. (2010); Gutierrez-Neito et al. (2009); Bassem (2008); Hermes et al. (2008); Gutierrez-Neito et al. (2007); Qayyum and Ahmad (2006); and Nghiem et al. (2006)), this paper's contribution to the literature is three-fold. Firstly, we use balanced panel data in the context of data envelopment analysis (DEA) to examine patterns and trends in the efficiency of MFIs, and to investigate the effect of MFI characteristics and the external environment. This brings to the fore some empirical newness, since we are able to disaggregate the efficiency of the same set of MFIs into pure technical and scale efficiencies over time. Secondly, bootstrapping the efficiency scores to enhance statistical inference leads to comparability of DEA with parametric stochastic frontier analysis (SFA), including Gonzalez (2008) and Hermes et al. (2009). Finally, spinning off from Nghiem et al. (2006)[3] and Hermes et al. (2009), which respectively use DEA and SFA, our second stage estimation will provide a platform to compare microfinance efficiency studies. With the backdrop that DEA efficiency scores are data specific, comparing results from different datasets is a 'pill hard to swallow'. However, recent developments, in particular Simar and Wilson (2007), make comparison plausible even in the context of different datasets. This paper uses both DEA and SFA. The use of parametric stochastic cost frontier analysis as a robustness test enables a validation of our hypotheses and an observation of potential differences, given the limitations of each of the estimation techniques.

The rest of the study is organised as follows. The next section reviews literature on microfinance efficiency, with an emphasis on its multiple objectives and attendant varying inputs and outputs. The third part looks at methods of study. The penultimate and final sections discuss results and extract the main findings for policy recommendations for both MFI management and public policy.

Efficiency in microfinance

In this paper, we provide a working definition for efficiency in microfinance as: using an optimal combination of inputs (staff time, staff number and cost of operation) to respectively disburse and reach the maximum number of loans and clients, especially the deprived, while delivering a range of valued services. This definition clearly points to a 'necessary' and 'sufficient' distinction between efficiency and sustainability. The former is the necessary condition for financial sustainability. While the relationship between financial sustainability and targeting poor clients maintains its importance in microfinance literature, institutional efficiency has recently come into the spotlight (see Blaine, 2009; Kneiding and Mas, 2009; Hermes et al., 2008; and Gutierrez-Neito et al., 2007). Two

[3] In this paper, Nghiem et al. (2006), using a dataset from Vietnam, show that efficiency scores between parametric and non-parametric estimates are comparable in the context of MFIs.

main reasons can be identified for the increasing drift of focus to MFIs' efficiency. First is the conceptual difference between sustainability and efficiency, and, secondly, the changing trend of operational expense in the industry. As a result, some questions have become apparent. These include: (1) does profitability/commercialisation correlate with efficiency? (2) Does reliance on subsidies beyond the 1995 donor consensus of a seven-to-ten-year transitional growth period of MFI imply inefficiency? And (3) what are the reasons for the sudden reversal of the falling operating expense/gross loan portfolio ratio? While this paper does not attempt to provide responses to these questions, it offers a platform for understanding different dimensions of the changing patterns and trends and determines the drivers of efficiency.

In spite of the commonality in MFIs inputs and outputs as in the working definition above, production functions in the industry differ markedly, both over time and space. Among the reasons accounting for the differences are: MFIs' inclination to either of the dual objectives (financial systems or poverty reduction); source of funds; regulation; external environment (information, competition and the macro economy); and delivery strategies. With the exception of delivery strategies, most of these factors are beyond managerial control. Examples of microfinance delivery strategies are: group vs. individual loans; voluntary and compulsory savings; technological intensity (electronic service devices and mobile phone); branchless (mobile) banking; and product mix. These different delivery strategies yield diverse production functions. Balkenhol (2007) asserts that collateral requirements and the extent to which cost is passed on to clients determine variations in MFIs' production functions. It is therefore imperative that empirical studies aimed at investigating MFIs' efficiency should take account of strategy heterogeneity, institutions' inclination to either of the dual objectives (financial and social), external environment and scope of sustainability measure.

The scope of financial sustainability measures MFIs' accounting/financial short- and long-term performance. Balkenhol (2007) articulates the distinction between financial/operational self-sufficiency (measure of MFIs' sustainability) and efficiency. From a sustainability point of view, the thrust of the argument revolves around the source and nature of financing and default. The former suggests that institutions relying on grants (subsidies) are less likely to be sustainable. Also improper account of portfolio at risk, both as an accounting report and monitoring, threatens the long-term operations of an MFI. To this end, Gutierrez-Neito et al. (2007) assert that in the context of financial efficiency, broad and narrow perspectives should be considered, based on the scope of financial sustainability. For instance, failure to make provision for loan losses yields a narrow viewpoint.

Closely related to contextualising the scope of MFI efficiency is the issue of intermediation and production approaches of measuring the efficiency of financial institutions. As a financial institution, its functional role should be viewed either from an

intermediation[4] or production[5] approach perspective (Berger and Humprey, 2007). The distinction is primarily linked with identification of inputs and outputs and has policy implications, depending on how a country views microfinance. In this paper, we argue that this distinction is masked by the dual (financial and outreach) objectives of MFIs. Table 1 catalogues some of the few microfinance economic efficiency empirical studies based on scope, methodology and orientation. While Table 1 identifies some conceptual inconsistencies in these studies – for instance, choice of variables for production approach between Haq et al. (2010) and Nghiem et al. (2006) –- its aim is far from that of comparing the respective strengths and weaknesses of these studies. This is in view of the contrasting motivation between them. For instance, while some studies aim at comparing MFIs, either within the same geographical area (Bassem (2008); Qayyum and Ahmad (2006)) or across different regions (Haq et al. (2010)), others attempt to explain determinants of an MFI's efficiency, either based on a declassification of goals –- financial and social (Gutierrez-Neito et al. (2009) – or assume homogeneity in the objective of all MFIs (Hermes et al. (2008); Gutierrez-Neito et al. (2007)).

Both parametric SFA and DEA have been employed in either calculating or estimating economic efficiency in microfinance. To the best of our knowledge, only one study (Nghiem et al., 2006) in the context of microfinance has compared efficiency scores from both parametric and non-parametric estimates. In their paper, they observe similar estimates/scores of MFIs' efficiency. This potentially suggests the comparability of both estimation techniques as asserted in the broader efficiency literature (FØrsund, 1992; Coelli and Perelman, 1999). As alluded to earlier, we remain silent on the superiority of either of these techniques; however, in the context of microfinance and the objectives of this study, DEA, in our opinion, facilitates a detailed assessment of the various facets of efficiency, notably pure technical and scale efficiency variants.

Decomposing efficiency into pure technical and scale yields an invaluable policy prescription for MFI management. Typically, they are able to identify phases of either increasing, constant and decreasing returns to scale. Also, due to the multiple objectives of microfinance and data restrictions on input prices and output quantities, DEA intuitively seems more suitable than SFA. Following on from Berger and Humphrey (2007), one can argue that since the microfinance paradigm has multiple objectives, it blurs the conventional cost and profit functions, at least from an operational viewpoint, making the application of parametric SFA somewhat problematic. Thus, in spite of the ingenuity evoked by Hermes et al. (2008; 2009) in arriving at input prices, it is practically difficult to disentangle social and financial efficiency, since total cost and inputs are assumed for the entire operation (financial and social) of the MFI.

[4] As an intermediary, MFIs transfer funds from savers to borrowers.
[5] MFIs are viewed as production units that employ traditional factors of production (capital and labour) to produce output.

Table 1: Orientation and scope of some published empirical microfinance economic efficiency studies

Studies	Goal	MFIs' dual objective	Orien-tation	Estim-ation technique	Production function	Approach	External	Inputs	Outputs	Study area
Hermes et al. (2009)	Compare MFIs and investigate determinants of efficiency	Sustainability	Cost (input)	SFA and second stage regression analysis	Translog	Intermediation	Type of MFI, trend, age, domestic credit, location, delivery strategy and average loan and savings balance	1. Operating expense (salary) 2. Financial expense (interest on deposits) 3. Total expenses	1. Gross loan portfolio	Global
Haq et al. (2010)	Compare MFIs	Sustainability	Dual-ity[+]	DEA[θ]	CRS[κ] and VRS[λ]	Intermediation and production	Type of MFI	1. Number of personnel 2. Cost per borrower 3. Cost per saver 4. Operating expense	1. Number of borrowers per staff member [I] 2. Number of savers per staff member [I] 3. Gross loan portfolio [P] 4. Total savings [P]	Africa, Asia and Latin America
Gutierrez-Neito et al. (2009)	Compare MFIs	Financial and social efficiency		DEA[θ]	CRS – (CCR)	Microfinance objective	Type of MFI and country effect	1. Assets 2. Operating cost 3. Number of employees	1. Gross loan portfolio [F] 2. Revenue [F] 3. Number of women [S] borrowers 4. Poverty index [S]	Africa, Asia Eastern Europe and Latin America
Bassem (2008)	Compare MFIs	Sustainability and outreach	Output	DEA[θ]	CRS[κ] and VRS[λ]	Production	Type and size of MFI	1. Number of personnel 2. Total assets	1. Return on assets 2. Number of women borrowers	Mediterranean (MENA)
Hermes et al. (2008)	Determine trade-off between efficiency and outreach	Efficiency and outreach	Cost (Input)	SFA	Translog	Intermediation	XX	4. Operating expense (salary) 5. Financial expense (interest on deposits) 6. Total expenses	2. Gross loan portfolio	Global
Gutierrez-Neito et al. (2007)	Compare MFIs and explore variations between financial and social efficiency	Sustainability		DEA[θ]	CRS – (CCR)	Microfinance objective	Type of MFI and country effect	1. Credit officers 2. Operating expense	1. Gross loan portfolio 2. Number of loan outstanding 3. Interest and fee income	Latin America
Nghiem et al. (2006)	Compare MFIs and investigate determinants of efficiency	Sustainability and outreach	Input	DEA[θ, γ] and Tobit regression	CRS[κ] and VRS[λ]	Production	Type, age and location of MFI	1. Labour cost 2. Administrative expense	1. Number of savers 2. Number of borrowers 3. Number of groups	Vietnam

+ - The study examines both the input and output orientation of achieving efficiency; θ - Data envelopment analysis; κ - Constant returns to scale; λ – Variable returns to scale; I – Intermediation model; P – Production model; γ – DEA is compared with parametric linear programming (PLP) and Stochastic frontier analysis (SFA); S – Social efficiency index; F – Financial efficiency index.

In the context of macroeconomic drivers of MFIs' efficiency, including financial development (depth), contrasting results currently exist. While Gonzalez (2008) fails to find any significant relationship, Hermes et al. (2009) show that financial development irrespective of the measure[6] improves MFIs' efficiency. However, an oversight remains, since the MFIs' inclination to either financial or social objectives might yield varying relationships. This study subscribes to a positive and significant effect between financial development and financial efficiency. This is premised on the notion that financial development comes along with competition for the entire financial sector industry and therefore, all things remaining the same, efficiency will be enhanced. However, the relationship between financial development and social efficiency is hypothesised to be negative, since prudential regulation is likely to come along with financial development. That is, should enforcement of prudential regulation accompany financial development, MFIs are likely to divert their attention to financial efficiency, to the neglect of social efficiency. Variants of this finding from a financial sustainability viewpoint have been observed by Hartaska and Nadolnyak (2007), Mersland and Strom (2009) and Cull et al. (2009). Though we assert an association between financial development and efficiency (financial and social), the direction of causality needs careful and rigorous investigation.

Other external environment factors, such as bureaucracy in property registration, contract enforcement delays, costs and complexities, and lack of information on credit availability, are hypothesised to affect social efficiency negatively. In a previous study, Gonzalez (2008) finds that the credit information index, which measures the degree of credit information availability in an economy, improves MFIs' efficiency. Table 2 tabulates the *a priori* signs for all the explanatory variables.

Method of study

On the backdrop of the two preceding sections, the empirical exposition underpinning the study's aim of investigating patterns and trends of MFIs' efficiency, and identifying efficiency drivers, is described in this section. The section is sub-divided into four headings with the aim of explaining: choice of variables; datasets; production function; and estimation techniques.

Selection of inputs and outputs, orientation and environmental factors

In contrast to reliance on either an intermediation or production approach for the selection of inputs and outputs, we are guided by the dual objectives of the microfinance paradigm. Gutierrez-Neito et al. (2007) and Gutierrez-Neito et al. (2009) argue that

[6] Four different measures of financial development were used in their study. These were: total liquid liabilities (measured as M3 to GDP ratio); lending minus borrowing interest rate; total domestic credit provided by the banks to GDP ratio; and total domestic credit to private sector to GDP ratio (Hermes et al. (2009)).

Table 2: Variable definition, measure and a priori expectation

Variables	Description	Efficiency hypothesis[e]		
		Financial	Operational	Outreach
Financial expense [a]	This includes interest and fee expense on deposits and borrowings plus other financial expense.			
Operating expense [a]	Personnel and administrative (depreciation, utilities, office supplies, transport, etc)[d]			
Total expenses [a]	Financial plus operating expense plus impairment losses[7]			
Personnel [a]	Total number of staff members			
Financial revenue [a]	Interest, fees and commissions on loan portfolio and other financial assets			
Gross loan portfolio [a]	Measure of outreach: all outstanding principals for all client loans			
Cost per staff (CPS)	Operating expenses to total assets ratio times total assets in US dollars, divided by total number of employees			
Cost per loan (CPL)	Financial expense divided by number of active borrowers.			
Number of women borrowers [a]	Number of active women	-	-	+
Not-for-profit NGO [a]	MFI classification but double as a proxy for regulation	-	+	+
Age of institution [a]	Number of years of operation	+	+	+
Domestic credit as a proportion of GDP [b]	Domestic credit provided by the banking sector including institutions that do not accept transferable deposits but do incur such liabilities as time and savings deposits. This figure excludes credit by the central bank.	+	+	+
Credit information index [c]	This measures rules affecting the scope, accessibility and quality of credit information available at public and private credit registries. The index ranges from 0 to 6, with higher values indicating availability of more credit information that shapes lending decisions.	+	+	+
Duration for property registration [c]	Measure of 'external' governance: captures the median duration that property lawyers, notaries or registry officials indicate as necessary to complete a procedure of registering a property.	–	–	–
Duration for contract enforcement [c]	Measure of 'external' governance: number of procedural steps necessary to enforce commercial disputes in relevant courts.	–	–	–
Operational self-sufficiency	Financial revenue/(financial expense + impairment loss + operating expense)	+	+	+
loan	Dummy = 1 if MFI relies on loans for on-lending and zero otherwise	+	+	–
Grant	Dummy = 1 if MFI relies on grant for on-lending and zero otherwise	–	+	+

Sources: a – Mix market; b – World development indicators; c – World Bank, doing business indicators; and d - (CGAP/World Bank, 2009); e – Signs are based on the Simar and Wilson (2007) statistical inference.

[7] This is a non-cash expense that estimates risk of default based on value of gross loan portfolio.

choice of either production or intermediation could be daunting and therefore they respectively use microfinance scope (financial and operational) and objective that choice of either production or intermediation could be daunting and therefore they respectively use microfinance scope (financial and operational) and objective (sustainability and outreach) for the selection of inputs and outputs. This study combines their respective approaches and asserts that in the context of microfinance it is reasonable to view sustainability and outreach in the light of intermediation and production, respectively. Thus as an intermediary, an MFI's main objective is to provide financial services with a poverty reduction oriented goal. While potential overlaps are indispensable, this approach offers a policy undertone based on the orientation of the MFI.

In addition to the complexity surrounding the conceptualisation and measurement of efficiency, Appendix II shows that, premised on MFIs' financial sustainability and outreach framework, five different perspectives can be examined. This multiplicity of microfinance efficiency perspectives further complicates quantitative empirical work. This paper concentrates on three of the five perspectives identified (see Figure 3 in Appendix I). As an extended version of Gutierrez-Neito et al. (2009), we exhaust both dimensions of financial sustainability (narrow and broad) and use number of women clients as an outreach (breadth) indicator. In effect, we calculate efficiency from three perspectives: narrow and broad perspectives of financial sustainability; and breadth of outreach. Variation between the narrow and broader perspective is based on the scope of expenses, with revenue remaining the same for both. From a narrow viewpoint, MFIs' efficiency is calculated based on financial expense, while in the broader context, total expense is used (see Table 2 for definition and measurement of variables). In the latter instance, we take into consideration provision for loan losses, which implies that the MFI is accounting for all possible credit risk (default).

The above emphasis on expenses offers an inclination for an input-oriented calculation of MFIs' efficiency scores. However, in view of the argument that different categories of MFIs possess varying levels of command over either inputs or outputs, then the duality approach might be suitable. The choice of an input orientation rather than that of an output is twofold. First, the notion of a huge segment of the population lacking access to financial services renders an output argument superfluous. Secondly, the approach to measuring MFIs' sustainable efficiency as described above makes it imperative to use an input-orientation.

Unlike examining financial efficiency from both dimensions of sustainability (broad and narrow), outreach is restricted to breadth of outreach for the sake of brevity. Despite this restriction, it is possible to measure the number of women reached from both depth and scale of outreach perspectives. Thus, based on the notion that women are the vulnerable sex and the strong evidence of a positive association between vulnerability

and poverty (Gaiha and Imai, 2004), a link can be deduced between breadth and depth of outreach. The use of number of women clients invariably offers information on MFIs' efficiency based on scale of outreach. To this end, there are three inputs used, namely: financial expense, operating expense and number of personnel for different models. On the flipside, four outputs were employed, including financial revenue, net operating income, gross loan portfolio (GLP) and number of women clients, also for different models.

Dixit (2009) and previous microfinance-efficiency related studies (Gonzalez, 2008; Hermes et al., 2009), respectively, provide a theoretical and empirical justification for the choice of country-level variables to represent the external environment. The second stage estimation regresses age of MFI (age), dummy on whether MFI is regulated or not (regulation), domestic credit as a proportion of gross domestic product (domcred), credit information index (credinfo), property rights (proright) and enforcement of contract (enfcont) on double bootstrap calculated efficiency from the first stage. The choice of variables is restricted to factors that are exogenous to the MFI production function, as identified in the literature. This notwithstanding, a couple of caveats are worth mentioning. Firstly, the inclusion of MFI type as a control variable and for purposes of comparison with previous studies such as Hermes et al. (2008) and Hermes et al. (2009) requires careful interpretation. This is because our experience in the industry and data cleaning process revealed that use of different category of MFIs (bank, not-for-profit financial non-governmental organisation, etc.) is country specific and not always informed by the classification of formal, semi-formal and informal financial institutions. Secondly, regulation can prove endogenous, but the use of truncated regression in the second stage inhibits our ability to mitigate the effect of endogeneity through known techniques, such as instrumental variable, HT and fixed effects vector decomposition. We are, however, optimistic that the estimation technique as described below to a considerable extent yields admissible results.

Data

Table 2 shows that multi-source data is employed in this study. While the calculation of efficiency scores relies solely on institutional level (MFI) data, the second stage estimation includes country-level variables. The MFI data is sourced from the MIX market, which is the most comprehensive and up-to-date global web-based information on MFIs. We generate a balanced panel of data and restrict data to only observations with non-missing values, since in a DEA context missing values are detested. The rationale for despising an unbalanced panel of data is to minimise the noise in the data mainly due to outliers. As mentioned earlier, DEA fails to take account of errors associated with the data. Although Simar (2003) and Tran et al. (2008) provide strategies for detecting outliers, and Simar and Wilson (2007) suggest estimation techniques that partially reduce the bias associated with noise from the data, we remain resolute on the need to institute a balanced data restriction for the same purpose. To this end, we engage 164 MFIs, located in 61 countries over a period of five years (2004–

2008). Country-level data for the second stage were sourced from World Development Indicators (domcred), the World Bank's Doing Business[8] data (credinfo) and the World Bank's governance indicators[9] (proright and enfcont).

Choice of production functional form

In view of CRS' implicit assumption that DMUs operate at their most efficient scale, we use VRS to help disentangle efficiency into pure technical and scale. The heterogeneity of MFIs' delivery strategies and varying inclination to the dual objectives undermines the relevance of the presumption that all institutions are operating at their optimal efficiency scale. Disaggregating efficiency into pure and scale facilitates attribution of inefficiency to either implementers (credit officers and 'second tier' managers) or planners (Board, owners).

Estimation

This study follows a three-step approach. Firstly, using DEA's Charnes-Cooper-Rhodes (CCR(CRS)) and Banker-Charnes-Cooper (BCC(VRS)) models, we calculate MFIs' efficiency scores, based on both scope of financial sustainability measure (narrow and broad) and objectives of the MFI (financial and outreach). Using data for the period 2004 to 2008, we are able to examine patterns and trends of MFIs' efficiency. Secondly, we estimate Simar and Wilson (2007) bias corrected efficiency scores and run a regression on internal and external explanatory variables of MFIs' efficiency. Thirdly, results emerging from the second estimation are benchmarked with a Translog cost frontier parametric analysis.

CRS and VRS input-oriented efficiency computation

The input-oriented technical efficiency is calculated by solving the following linear programming for each of the 164 MFIs in a particular year. Computing an input-oriented technical efficiency literally points to investigating the extent to which an MFI's inputs can be reduced relative to others with output remaining unchanged. DEA's computation of technical efficiency accounts for slacks. In this case an MFI is efficient only if it is not possible to reduce input without worsening another input or output (Pareto-Koopmans definition of efficiency).

In Equation 1 below, we aim at minimising input θ subject to the inequality constraint that offers two possibilities of either increasing output or decreasing inputs. In the case of VRS, the third constraint representing convexity restricts the sum of the weights to unity and that allows for the computation of only pure technical efficiency.

$$\min_{\theta,\pi} \theta \qquad 1$$

[8] http://www.doingbusiness.org/MethodologySurveys/
[9] http://info.worldbank.org/governance/wgi/index.asp

$$\sum_{j=1}^{j} \tau_j Y_{mj} \geq Y_j \qquad 2$$

$$\sum_{j=1}^{j} \tau_j X_{nj} \leq \theta X_j \qquad 3$$

For all n=1,…., N, m=1,…,M and θ and τ ≥ 0.

$$\sum_{j=1}^{j} \tau_j = 1 \qquad 4$$

where θ measures efficiency (extent to which inputs should be minimised in order for each MFI to operate on the frontier); τ represents weights computed from a fractional linear programming and represents intensity required to generate relative efficiency scores for each MFI; Y and X are respectively the amount of output (financial revenue and gross loan portfolio) and input (operating expense and personnel) produced by MFI j; and M and N symbolise number of outputs and inputs, respectively.

With the estimation of both CCR(CRS) and BCC(VRS), we are able to decompose technical efficiency into pure technical and scale. Thus, by dividing CCR by VRS as in Equation 5 below, we arrive at scale efficiency values.

$$Scale\ Eff_{\cdot j} = {}^{\theta_j\ CRS}\Big/_{\theta_j VRS} \qquad 5$$

Bias-corrected efficiency scores and second stage estimation

In view of DEA's lack of statistical properties, especially given the non-inclusion of data noise, Simar and Wilson (2007) suggest a coherent data generation process (DGP) via bootstrap method to enhance an approximation of the asymptotic distribution and to correct the biases of estimated coefficient. The aim of their paper was to provide a technique to resolve: (1) the bounded error nature of efficiency scores; and (2) some statistical problems, notably serial correlation. Simar and Wilson (2007: 19) argue that serial correlation is complicated in unknown ways, given the following: (1) the error from the first stage efficiency frontier estimation is unquestionably correlated with the set of environmental factors; (2) parametric convergence rates of the maximum likelihood estimates of the coefficients will be slow; and (3) the expected zero mean of the bias associated with the estimated efficiency score from the first stage is not guaranteed. Following Simar and Wilson's (2007) Algorithm #2, we generate bias-corrected

estimates in the first stage using parametric bootstrap and determine the effect of efficiency drivers in the second stage using truncated regression.

Translog cost frontier parametric estimation

Following on from Battese and Coelli (1995), and as applied in Hermes et al. (2009), a Translog stochastic cost frontier function for MFIs requires information on total cost, output quantities, and vector of input prices. Based on Hicks' assumption, which implies that technical-technological progress is neutral, a simplified Translog production function can be specified in Equation 6 below, as follows:

$$\begin{aligned} lnTC_{it} = \beta_0 + \beta_1 lnCPS_{it} + \beta_2 lnCPL_{it} + \beta_3 lnGLP_{it} + \beta_4 lnCPS^2{}_{it} + \beta_5 lnCPL^2{}_{it} \\ + \beta_6 lnGLP^2{}_{it} + \beta_7 (lnCPS * lnCPL)_{it} + \beta_8 (lnCPS * lnGLP)_{it} \\ + \beta_9 (lnGLP * lnCPL)_{it} + V_{it} + U_{it} \qquad 6 \end{aligned}$$

where TC represents total expenses of the MFI; CPS corresponds to the unit price of a staff member; CPL symbolises the unit price of handling loan portfolio; GLP stands for gross loan portfolio (quantity of output); V_{it} is the traditional error term, which is assumed to be independent and identically distributed (iid) with a mean of zero and a variance of $\sigma^2{}_v$; and U_{it} denotes non-negative random variables also iid but with truncated normal distribution with mean $z_{it}\delta$ and variance , σ^2. Furthermore, z_{it} represents a (1 x m) vector of explanatory variables associated with technical inefficiency and δ is an (m x 1) vector of unknown coefficients (Battese and Coelli, 1995). Predicted values generated from the above equation represent technical inefficiency of institutions and as such negative(positive) coefficients naturally signify that the explanatory variable in question improves(reduces) efficiency. Table 2 provides definition for variables used in Equations 6 and 7.

Following a one-step maximum likelihood estimation of Battese and Coelli (1995), the external environment and MFI-specific drivers of estimated inefficiency can be specified in Equation 7 as follows:

$$\begin{aligned} z_{it} = \beta_0 + \beta_1 PrR_{it} + \beta_2 EnfC_{it} + \beta_3 CrInf_{it} + \beta_4 OSS_{it} + \beta_5 WomB_{it} + \beta_6 DomC_{it} \\ + \beta_7 SFL_{it} + \beta_8 SFG_{it} + \beta_9 Age_{it} + \beta_{10} NNGO_{it} + U_{it} \qquad 7 \end{aligned}$$

where PrR denotes duration for registering a property; EnfC symbolises duration for contract enforcement; CrInf stands for credit information index; OSS signifies operational self-sufficiency; WomB indicates number of women borrowers; DomC refers to domestic credit divided by GDP; SFL and SFG respectively mean sources of funds from loans and credit; NNGO (not-for-profit NGO) connotes type of institution and doubles as proxy for regulation; βs represent the coefficients of the set of external environment and MFI-

specific variables; and the subscript '*it*' shows that the variables are for each institution (country) and for a given year.

Results and discussion

We precede this section with a brief descriptive statistic (median) across regions. The input/output variables for the production function and the explanatory factors of estimated efficiency are described prior to a discussion on the inferential statistics. In line with the objectives of this study, the results and discussion are presented as follows: (1) patterns and trends of disaggregated efficiency (pure technical and scale) based on MFI scope of financial sustainability measure (narrow and broad) and objectives (financial systems or poverty reduction); (2) comparison of observed efficiency trends and previous studies using operating expense ratio; and (3) examination of the set of coefficients likely to drive efficiency of MFIs. Interpretation of results and inference are tailored to model specification and the type of statistical software used. The latter is as a result of the evolving nature of statistical and econometric software's incorporation of the various dimensions of efficiency computation. Efficiency scores to examine patterns are computed based on the DEA model and use of STATA 10. Ji and Lee (2009) for the first time provide a platform in STATA to estimate DEA based on Farrell's (1957) efficiency computation. Estimates derived are interpreted in the context of technical efficiency. Simar and Wilson's (2007) parametric bias-corrected efficiency estimates generate Shephard's (1970) distance function using FEAR 1.12, which is built on the R software platform. For the sake of consistency, we find the reciprocal of Shephard's (1970) estimates to arrive at Farrell's (1957) technical efficiency. MFIs with a score of one lie on the frontier, and the closer an institution is to the frontier (one) the greater the level of efficiency. By contrast, the parametric stochastic frontier estimates technical inefficiency and for that matter has a reverse interpretation.

Descriptive statistic

We rely on the median for the summary statistic in view of observed outliers. For example, in terms of an MFI's personnel, BRAC in Bangladesh has a staff capacity of approximately 24,453, compared to an overall average of 459 (minus BRAC). Observed patterns of single indicators were consistent with our expectations. For instance, size of operations (gross loan portfolio) is larger in South Asia (SA) and Latin America and the Caribbean (LAC) than the other four regions. This can be attributed to the predominance of microfinance activities in these two regions relative to the others. Examining operating expense and financial revenue to infer performance/efficiency based on a single input and output, we observe a positive correlation. This directly suggests that institutions

Table 3: Descriptive statistic (median) across regions

Variables		Regions						
Input/output		*SSA[1]*	*EAP[2]*	*ECA[3]*	*LAC [4]*	*MENA[5]*	*SA[5]*	*ALL*
	Operating expense [a]	2757443	1876923	1113221	1970971	1371735	3277104	1819579
	Personnel [a]	215	251	56	127	116	769	133
	Gross loan portfolio [a, b]	8186146	8133794	6771017	8302929	7647169	19900000	8005443
	Financial revenue [a]	4284150	3137801	2141785	3377599	2214420	5472288	2868730
	Women borrowers [a, b]	15278	40427	2427	11579	12412	83556	10885
	Cost per staff [b]	12798	6802	21535	16390	12749	3664	14713
	Cost per loan [b]	10.60	8.78	83.72	46.23	6.05	9.83	21.56
Efficiency drivers								
	Age of institution	12	13	8	14	10	11	10
	Operational self-sufficiency	110	131	125	118	129	110	120
	Credit information index	1	0	4	5	2	2	4
	Duration for property Registration	9	7	7	7	7	5	7
	Duration for contract Enforcement	39	44	38	38	40	46	39
	Domestic credit as a proportion of GDP	17.50	16.23	31.54	42.84	90.71	59.28	40.79

1- Sub-Saharan Africa; 2 – East Asia and Pacific; 3 – Eastern Europe and Central Asia; 4 – Latin America and the Caribbean; 5 – South Asia; 6 – Middle East and North Africa; a – variable used DEA; b – variable used for parametric SFA.

investing more reap higher. However, some drift away from the above is observed, given patterns of gross loan portfolio and personnel in LAC compared to sub-Saharan Africa (SSA) and East Asia and the Pacific (EAP). That is, although LAC has a higher gross loan portfolio, it employs only about 50 percent of the size of SSA as well as EAP.

Similar to patterns of microfinance prevalence across regions, financial depth at the macro level shows that SSA and EAP have the lowest rates. In the context of the debate between financial sustainability and efficiency, the highest OSS is recorded in EAP. Comparing this pattern with the earlier observation on efficiency (operating expense) an early bird inference for EAP is a potential trade-off between operational sustainability and efficiency.

Patterns and trends of efficiency

In the context of pure technical and scale dimensions of efficiency, we focus on the location and institutional patterns of MFIs. As a recall, pure technical efficiency is mostly attributed to managerial/implementation decisions while scale efficiency is associated with the size of operations and normally aligned with the role of top

management/owners. In view of the computational assumptions underlying constant returns to scale (CRS) and variable returns to scale (VRS), pure technical efficiency values are necessarily lower than scale efficiency scores. As indicated earlier, these dimensions of efficiency are examined in the context of the scope of financial sustainability and objectives of MFIs. Tables 4a and 4b show that overall (without disaggregating by location and type of MFI), pure technical and scale efficiencies have changed differently across patterns and directions over time. With the exception of an increase in narrow financial efficiency, all other scores reveal a fall over the period 2007 to 2008. Since the broad measure takes into consideration the effect of loan losses, it provides a convincing true measure of the MFI's performance. This finding to a large extent validates observations emerging from the use of ratios to capture efficiency trends. Thus, the effect of the global financial crisis could have impacted adversely on the efficiency of MFIs.

Pure technical efficiency tends to show upward changes, while scale (size of operations) points to a reduction. This pattern is observed irrespective of the scope of sustainability measure or objective of the MFI. The increasing efficiency score for pure technical efficiency signals improvement in MFIs' strategies. This can be attributed to the wide scope of innovations that have recently sprung up in the industry. Among these are branchless banking and electronic service delivery. This finding is consistent with Haq et al.'s (2010) conclusion that over time, cost-efficient managers have better managed and monitored clients' financial activities. On the flipside, the declining scale efficiency potentially suggests that MFIs have reached their optimum size of operations, in which case further increases are slowing performance. In this regard, revisiting the likelihood of an overestimated demand for financial services is a worthy course.

While ECA consistently recorded the highest pure technical scores, scale efficiency shows some variations depending on the objective of the MFI. Though lamentable, the increasing focus of commercial funding to the region in the past few years might be a reason for improved managerial efficiency. However, due to regional, country and MFI-specific effects, it is largely difficult and inappropriate to push forward such plausible reasons. Comparing efficiency of MFIs across pure technical and scale, we observe that the most populated regions (ECA and SA) score high for the latter, but not necessarily for the former. In the context of overall declining scale efficiency, this prompts the need for populated regions to assess strategies for improving their managerial operations. Broadly, these findings justify the need for identifying the best practices of efficient MFIs.

Efficiency superiority of different categories of MFIs[10] varies consistently over time depending on: (1) pure technical and scale efficiency; and (2) scope of financial

[10] Since the last category (other) is difficult to describe, we restrict the comparison of different types of MFIs to banks, non-bank financial institutions (NBFIs), not-for-profit non-governmental organisations (NNGOs) and credit union/cooperatives (CUCs).

sustainability measure and objectives of MFIs. Banks' superior efficiency advantage in the context of financial, managerial and technical operations (pure technical) is confirmed. Table 4b shows that out of the 15 dimensions of pure technical efficiency – five institutions (over five years) and three different perspectives (narrow, broad and outreach)) – banks record the highest score 11 times. On the flipside, and unexpectedly, social efficiency (outreach) superiority of not-for-profit non-governmental

Table 4a: Patterns of MFIs mean efficiency across regions and over time

Year	Region	Efficiency					
		Pure technical (VRS)			Scale (CRS/VRS)		
		Sustainability		Outreach	Sustainability		Outreach
		Narrow	*Broad*	*Outreach*	*Narrow*	*Broad*	*Outreach*
2004	SSA	0.422	0.585	0.657	0.873	0.944	0.973
	EAP	0.342	0.480	0.600	0.758	0.924	0.984
	ECA	0.483	0.649	0.668	0.906	0.963	0.969
	LAC	0.448	0.577	0.613	0.836	0.935	0.951
	MENA	0.341	0.555	0.604	0.847	0.948	0.976
	SA	0.357	0.423	0.559	0.828	0.933	0.982
	ALL	***0.427***	***0.575***	***0.628***	***0.856***	***0.945***	***0.967***
2005	SSA	0.406	0.538	0.600	0.874	0.956	0.982
	EAP	0.367	0.518	0.620	0.759	0.932	0.986
	ECA	0.504	0.652	0.671	0.920	0.971	0.975
	LAC	0.460	0.596	0.630	0.853	0.936	0.957
	MENA	0.361	0.565	0.611	0.831	0.942	0.978
	SA	0.422	0.467	0.632	0.763	0.916	0.980
	ALL	***0.444***	***0.583***	***0.634***	***0.857***	***0.947***	***0.972***
2006	SSA	0.414	0.538	0.608	0.875	0.961	0.982
	EAP	0.390	0.554	0.626	0.750	0.926	0.986
	ECA	0.553	0.667	0.681	0..925	0.973	0.976
	LAC	0.492	0.613	0.645	0.852	0.932	0.956
	MENA	0.408	0.581	0.628	0.820	0.945	0.964
	SA	0.472	0.520	0.672	0.750	0.882	0.974
	ALL	***0.480***	***0.601***	***0.649***	***0.856***	***0.944***	***0.970***
2007	SSA	0.415	0.533	0.599	0.872	0.947	0.981
	EAP	0.444	0.585	0.665	0.749	0.918	0.980
	ECA	0.625	0.700	0.711	0.930	0.969	0.972
	LAC	0.527	0.637	0.672	0.864	0.933	0.953
	MENA	0.452	0.631	0.674	0.819	0.928	0.960
	SA	0.529	0.559	0.710	0.683	0.837	0.925
	ALL	***0.525***	***0.628***	***0.675***	***0.854***	***0.935***	***0.962***
2008	SSA	0.421	0.534	0.603	0.868	0.948	0.978
	EAP	0.488	0.586	0.675	0.742	0.924	0.974
	ECA	0.656	0.694	0.705	0.927	0.962	0.963
	LAC	0.532	0.622	0.653	0.865	0.926	0.946
	MENA	0.463	0.605	0.641	0.818	0.925	0.955
	SA	0.562	0.574	0.713	0.653	0.813	0.921
	ALL	***0.543***	***0.620***	***0.666***	***0.850***	***0.929***	***0.956***

Table 4b: Patterns of MFIs mean efficiency across type of MFI and over time

Year	Types of MFIs	Efficiency					
		Pure technical (VRS)			Scale CRS/VRS)		
		Sustainability		Outreach	Sustainability		Outreach
		Narrow	*Broad*	*Outreach*	*Narrow*	*Broad*	*Outreach*
2004	BANK	0.509	0.607	0.626	0.848	0.946	0.955
	NBFI [a]	0.419	0.587	0.630	0.891	0.962	0.977
	NNGO [b]	0.404	0.554	0.631	0.819	0.924	0.960
	CUC [c]	0.583	0.644	0.645	0.895	0.953	0.956
	Other [d]	0.257	0.352	0.393	0.778	0.987	0.997
	ALL	***0.427***	***0.575***	***0.628***	***0.856***	***0.945***	***0.967***
2005	BANK	0.557	0.650	0.685	0.842	0.919	0.926
	NBFI [a]	0.455	0.599	0.643	0.887	0.966	0.983
	NNGO [b]	0.401	0.552	0.622	0.825	0.933	0.972
	CUC [c]	0.560	0.638	0.640	0.908	0.948	0.951
	Other [d]	0.287	0.404	0.433	0.813	0.981	0.991
	ALL	***0.444***	***0.583***	***0.634***	***0.857***	***0.947***	***0.972***
2006	BANK	0.623	0.669	0.701	0.826	0.905	0.916
	NBFI [a]	0.501	0.634	0.677	0.885	0.962	0.983
	NNGO [b]	0.428	0.558	0.621	0.824	0.933	0.969
	CUC [c]	0.556	0.631	0.634	0.923	0.942	0.946
	Other [d]	0.277	0.399	0.428	0.794	0.962	0.987
	ALL	***0.480***	***0.601***	***0.649***	***0.856***	***0.944***	***0.970***
2007	BANK	0.646	0.704	0.730	0.842	0.885	0.902
	NBFI [a]	0.577	0.661	0.701	0.876	0.954	0.975
	NNGO [b]	0.455	0.585	0.651	0.827	0.924	0.963
	CUC [c]	0.557	0.639	0.640	0.914	0.932	0.935
	Other [d]	0.245	0.452	0.494	0.795	0.938	0.983
	ALL	***0.525***	***0.628***	***0.675***	***0.854***	***0.935***	***0.962***
2008	BANK	0.684	0.697	0.722	0.850	0.894	0.901
	NBFI [a]	0.609	0.659	0.694	0.863	0.943	0.967
	NNGO [b]	0.455	0.565	0.631	0.829	0.923	0.961
	CUC [c]	0.577	0.677	0.678	0.911	0.909	0.910
	Other [d]	0.286	0.503	0.541	0.801	0.920	0.977
	ALL	***0.543***	***0.620***	***0.666***	***0.850***	***0.929***	***0.956***

a – Non-bank financial institution; b – Not-for-profit NGO; c – Credit unions and cooperatives; d – Other forms of MFIs; and e – Includes rural banks and other financial institutions offering some form of microfinance.

organisations (NNGOs) is not consistently observed. From both pure technical and scale efficiency viewpoints, banks and non-bank financial institutions (NBFIs) respectively

emerge superior on the front of social efficiency. However, on average terms for scale social efficiency, NNGOs possess relative superior advantage. Therefore, in spite of the findings from average terms and earlier studies (Haq et al., 2010 and Gutierrez-Neito et al., 2009), the dichotomy between pure technical and scale social efficiency of different categories of MFIs is worth examining.

Credit union/cooperative appears to possess competitive efficiency scores across different measures and objectives of MFIs. For instance, prior to 2006, credit union/co-operative (CUC) was the most efficient category of MFI, irrespective of MFIs' inclination to either of the dual objectives. In terms of size of operations (scale), NBFI consistently emerged as the most efficient MFI category over time and across financial (broad and narrow) and social efficiency perspectives.

Benchmarking the observed findings with Figure 1 in Appendix I, the concern ignited by the flat curvature depicting increasing and rising cost of operating expense is sustained. Efficiency scores from this study show varying trends and patterns, depending on the type of measure and MFIs' objectives. Figure 2 fails to reveal marked changes, with the exception of the narrow definition of financial efficiency. As these findings spark a number of questions, the next section identifies the drivers of efficiency, to enable some inference.

Drivers of efficiency

Table 2 indicates that in our models (DEA bias-corrected truncated regression and parametric SFA) outreach (number of women), sources of funds (loans and grants) and regulation (banks and NNGOs) are hypothesised to have different effects, depending on the scope of financial sustainability and objectives of the MFIs. We argue that all other variables will have the same directional effect, irrespective of the scope of financial sustainability measure and objective of MFI. The *a priori* signs are informed by both previous empirical studies and intuition. For instance, it is intuitive to posit that longer duration in both property registration and enforcement of contract reduces the efficiency of MFIs. Also, as established in the microfinance industry and empirically verified by Gutierrez-Neito et al. (2009), NNGOs are expected to have a positive (negative) sign in terms of social (financial) efficiency.

As a recall, the specific hypotheses are: (1) operational financial sustainability complements efficiency (financial and social); (2) MFIs' targeting women trade-off their financial efficiency; and (3) external environment (credit information, property rights and financial development) has a significant positive effect on MFIs' social efficiency, while financial development impacts only on financial efficiency. Tables 5 and 6 respectively use efficiency and inefficiency data as the dependent variable, hence signs of the coefficients are interpreted in this regard. That is, positive signs in Table 5 are comparable to negative signs in Table 6. The same explanatory variables are used in

both estimates for purposes of comparability. Consistent with long-run neo-classical production theory, which suggests co-movement in capital and labour, the parametric SFA results in Table 6 (using the translog production function of Equation 6) identify collinearity among the input variables. However, with the exception of cost per loan, other inputs and quantity of output significantly determine efficiency scores.

Operational self-sufficiency, a measure of MFIs' financial sustainability, consistently explains efficiency. Irrespective of an MFI's objective and estimation technique, operational self-sufficiency (OSS) indicates a positive relationship with efficiency. The observed link between OSS and efficiency augments the case for commercialisation of MFIs, since it transcends the promotion of financial efficiency to facilitate the achievement of the poverty reduction (outreach) objective. In contrast to OSS consistently complementing efficiency, mixed results emerge on the relationship between outreach and efficiency. Similar to the findings of Hermes et al. (2008; 2009), the hypothesis of a trade-off between outreach and efficiency is observed in the one-step maximum likelihood parametric stochastic frontier estimation. This directly suggests that targeting women comes with a cost. However, the parametric SFA estimation is unable to provide further information of the type of cost. While Table 5 indicates that there is not enough evidence to support the association between financial efficiency and outreach, the last column signals a positive relationship between the latter and social efficiency. The parallel results of a trade-off between outreach and efficiency in Table 6, and a complementary relationship in Table 5, set the stage for segmenting MFIs based on their relative efficiency in dispensing either of the dual objectives. This suggests that contextualising type of efficiency and identifying best performing MFIs remains imperative for the success of the MFI industry.

In a similar vein, and intuitively, other variables (source of funds and regulation) that were hypothesised in Table 2 to have varying signs, depending on MFIs' objectives, show contrasting results when we compare the estimates of the disaggregated efficiency scores in Table 5 with those of the parametric SFA in Table 6. Despite methodological issues, the contrasting results reinforce the need to contextualise scope of efficiency measure (broad and narrow) and MFI objectives. NNGOs consistently show a reducing effect on efficiency, irrespective of methodology, scope of financial efficiency measure and MFI's objective. While this suggests a gloomy situation for NNGOs, it needs to be interpreted in the context of pure technical efficiency, since the descriptive statistics revealed that NNGOs had the highest overall social efficiency average score, given size of operation (scale).

Table 5 shows that in contrast to most of the external environment factors explaining social efficiency (credit information, duration for registering a property and enforcing contract), none of them is significant in determining narrow efficiency and only a couple

Table 5: Efficiency drivers of bias-corrected pure technical DEA estimates[11]

MFI specific characteristics and external environment	Narrow financial efficiency		Broad financial efficiency		Social efficiency (breadth of outreach)	
	Coef.	z-value[a]	Coef.	z-value	Coef.	z-value
Property registration	-0.011	(-1.24)	-0.001	(-0.89)	-0.006	-(3.96)**
Credit information index	0.002	(0.16)	0.014	(10.48)**	0.009	(5.73)**
Contract enforcement	-0.009	(-1.51)	-0.001	(-1.22)	0.002	(2.13)*
Operational self-sufficiency	0.404	(3.01)**	0.369	(28.62)**	0.354	(23.70)**
Women borrowers	0.000	(1.74)+	0.000	(0.40)	0.000	(2.22)*
Domestic credit/GDP	-0.001	(-1.36)	0.000	(-3.30)**	0.000	(-0.11)
Loan as a source of funds	-0.141	(-2.14)*	-0.016	(-1.74)+	0.016	(1.50)
Grants as a source of funds	-0.151	(-3.39)**	-0.008	(-1.16)	-0.008	(-0.94)
Age	0.008	(0.75)	0.002	(1.11)	0.006	(2.25)*
Age^2	-0.001	(-1.64)	0.000	(-1.00)	0.000	(-2.19)*
Year dummy for 04 -07	-0.118	(-2.83)**	-0.029	(-3.99)**	-0.020	(-2.23)*
Bank	-0.007	(-0.14)	0.027	(2.27)*	0.029	(2.29)*
Not-for-profit NGO	-0.078	(-1.67)+	-0.040	(-6.57)**	-0.017	(-2.39)*
Constant	0.690	(2.74)**	0.154	(4.37)**	0.088	(2.33)*
Sigma	0.342	(4.12)**	0.073	(28.70)**	0.088	(32.95)**
Number of observations	753		753		753	
Wald chi-square (Prob.)	59.67.72 (0.000)		1342.36 (0.000)		820.91 (0.000)	

a - Z- values are based on 1,000 bootstrap estimations of the truncated regression. ** - significant at one percent; * - significant at five percent; + - significant at 10 percent

explained the broader perspective of financial efficiency. This finding is consistent with the argument that the outreach objective of MFIs requires an external drive and their financial performance is mainly internally determined.

In Tables 5 and 6, longer property registering duration indicates a reducing effect on efficiency. However, there is a lack of sufficient statistical evidence to support the link between duration for registering a property and financial efficiency in the case of the bias-corrected DEA scores. In spite of this, the observed efficiency-reducing effect of longer property registering duration indicates a transmission mechanism through which MFIs' efficiency can be enhanced. Consistent with Hermes et al. (2009), an improving efficiency effect is observed for the measure of financial deepening in the context of parametric SFA. This finding is modestly articulated, as the DEA analysis fails to confirm the significant effect.

[11] The variation in sample size for the two estimations is as a result of the different estimation techniques. For instance, the truncation from Table 5 drops observations at the extremes.

Table 6: One-step maximum likelihood parametric stochastic frontier estimation [28]

Estimating inefficiency			Determining drivers of efficiency		
Input prices, quantity of output and Hicks' natural technical-technological progress	**Coef.**	**z-value**	**MFI specific characteristics and external environment**	**Coef.**	**z-value**
ln of (cost per staffsq)	0.368	(3.52)**	Property registration	0.035	(6.11)**
ln of (cost per loansq)	-0.043	(-0.69)	Credit Information index	-0.008	(-1.14)
ln of (gross loan portfoliosq)	0.553	(9.66)**	Contract enforcement	-0.001	(-0.45)
ln of (cost per staff)*ln of (cost per loan)	-0.031	(-2.89)**	Operational self-sufficiency	-0.778	(-12.7)**
ln of (cost per staff)*ln of (gross Loan portfolio)	-0.034	(-2.58)*	Women borrowers	0.000	(4.85)**
ln of (cost per loan)*ln of (gross loan portfolio)	0.024	(3.78)**	Domestic credit/GDP	-0.001	(-3.23)**
Year	0.020	(1.66)*	Loan as a source of funds	0.047	(1.25)
Constant	-46.42	(-1.90)*	Grants as a source of funds	-0.119	(-4.08)**
			Age	0.045	(4.78)**
			Age^2	-0.001	(-4.40)**
			Year dummy for 04 -07	0.048	(0.95)
			Bank	0.007	(0.15)
			Not-for-profit NGO	0.096	(3.27)**
			Constant	1.176	(6.33)**
			Number of observations	736	
			Wald chi-square(7)	9275.81 (0.000)	
			Lnsigma2	-2.3945 (0.000)	

** - significant at one percent; * - significant at five percent; + - significant at 10 percent

Conclusion

This study set out to examine patterns, trends and drivers of MFIs' efficiency in the context of underlying returns to scale assumptions (pure technical and scale) and the dual objectives (financial and social) of the microfinance paradigm. The anecdotal evidence of some connection between the recent global financial crisis and the slowdown of microfinance operations is sustained. This is primarily due to the observation that the broader financial and social efficiency measures exhibit a turning point in 2007. In contrast to the narrow financial efficiency measure, the broad and social efficiency measures provide a comprehensive and true picture of microfinance operations.

Mapping MFI classification onto the type of efficiency measure and objectives of the microfinance paradigm offers revealing relative advantage superiority results. The evidence of NBFIs and CUCs closely competing with banks and NNGOs on their known respective advantages of financial and social efficiency provides alternatives for interventions and the possibility of linkages to tap specialised niches of each MFI category.

On the front of efficiency drivers, complementarity between financial sustainability and efficiency is confirmed. The observed varying relationship between outreach and efficiency as a result of the nature of conceptualisation, institutional goal and methodology indicates the need for: (1) identifying MFIs with their objectives; and (2) engaging in further country and institution-specific studies. This study also confirms the argument that, unlike the financial goal, MFIs' social efficiency and outreach require the role of external factors, including other institutions providing services within the business environment. The ability of such institutions in reducing bureaucracy that unduly delays economic transactions and in providing financial-related information improves the social efficiency of microfinance institutions.

With most of the institutions, depicting increasing returns to scale, identifying and absorbing any external adverse shock will add to the bright future of the microfinance paradigm. That is, in spite of the observed size of operation (scale) constraint, MFI operational (managerial) performance is fertile and can be harnessed for the growth of the industry.

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Appendix I

Figure 1 - Trend of gross loan portfolio and operating expense

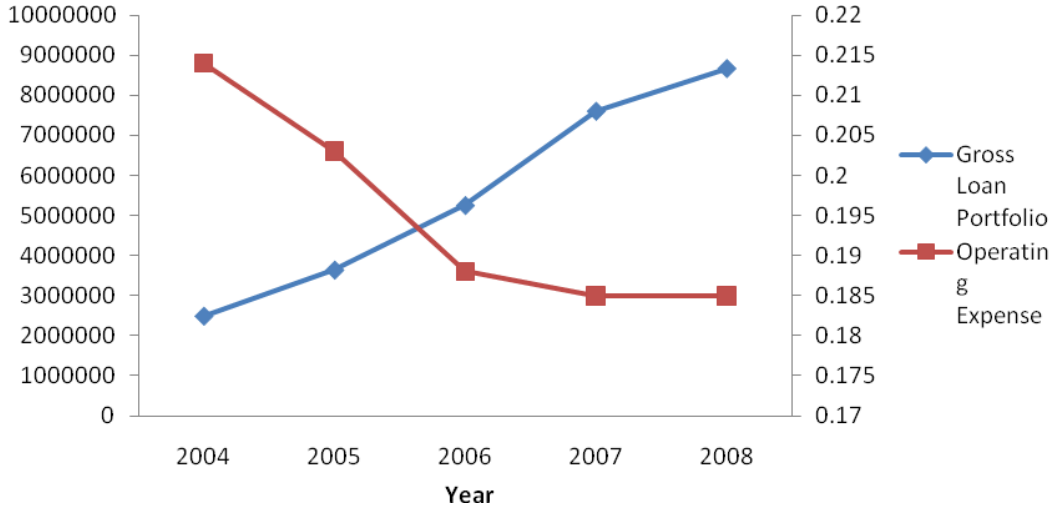


Figure 2: Pure technical and scale efficiency of MFIs' objectives

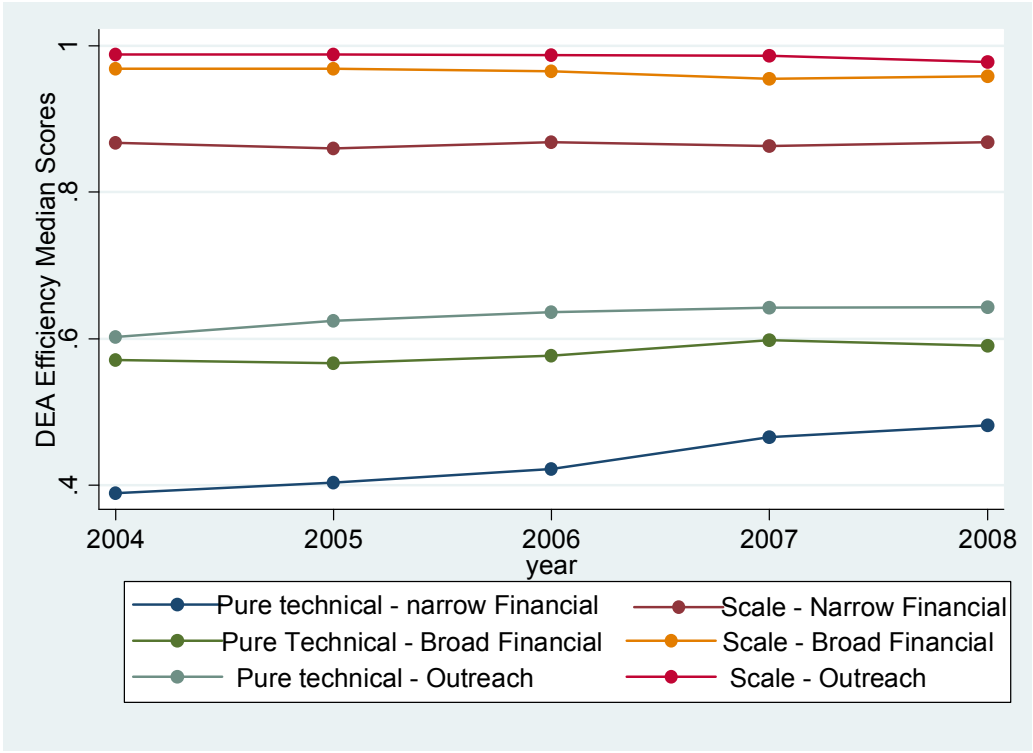
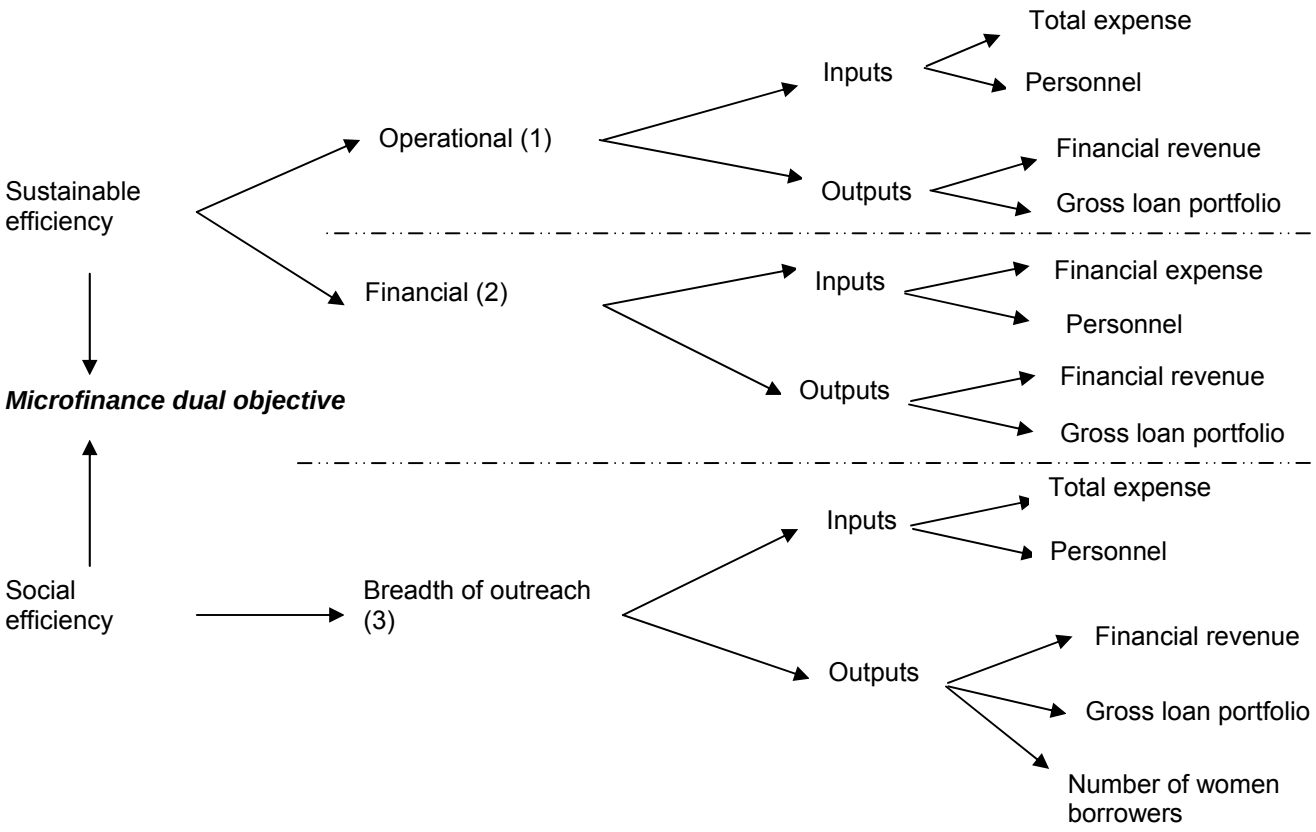


Figure 3: Scope of efficiency measure based on microfinance objectives



Appendix II

Scope of MFIs inputs/outputs based on sustainability and outreach

Goals of microfinance institutions		Type of efficiency	Input	Output Intermediation/production models
Sustain-ability	Financial	Technical/ allocative efficiency?	Operating expense	Financial revenue
			Personnel	Gross loan portfolio [I]
			Total assets	
			Total equity	
			Total expense	Financial revenue [I]
	Operational	Technical/ allocative efficiency?	Total assets	Gross loan portfolio [I]
			Personnel	
			Total equity	
Outreach[12]	Scale[13]	Technical/ allocative efficiency?	Operating/financial expense	Number of active borrowers [P]
			Personnel	Number of depositors [P]*
	Depth[14]	Technical/ allocative efficiency?	Total assets	Average loan size/GNI per capita
	Breadth[15]	Technical/ allocative efficiency?	Total equity	Total number of women borrowers [P]

[12] Other dimensions of outreach, including length and scope, have been excluded from this framework for purposes of brevity.
[13] Scale of outreach measures the magnitude of clients simply in terms of numbers.
[14] Depth of outreach captures the relativity or extent of poor clients reached by the MFI.
[15] Breadth of outreach in this paper is defined as the economic and demographic characteristics of clients.

Appendix III

Geographical spread of microfinance institutions

Regions	Country-N (%)	MFIs-N (%)
Africa (SSA)	13 (21)	24 (15)
East Asia and Pacific (EAP)	4 (7)	12 (7)
Eastern Europe and Central Asia (ECA)	17 (28)	46 (28)
Latin America and the Caribbean (LAC)	15(25)	50 (30)
Middle East and North Africa (MENA)	7 (11)	17 (10)
South Asia (SA)	5 (8)	15 (9)
Total	61 (100)	164(100)

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