



Munich Personal RePEc Archive

Productivity and Efficiency Analysis of Microfinance Institutions (MFIS) in Bangladesh

Bairagi, Subir

Centre for Policy Dialogue (CPD)

December 2014

Online at <https://mpra.ub.uni-muenchen.de/67917/>

MPRA Paper No. 67917, posted 18 Nov 2015 05:36 UTC

Productivity and Efficiency Analysis of Microfinance Institutions (MFIS) in Bangladesh

Subir Bairagi*

Abstract

This paper estimates productivity and efficiency of ten major microfinance institutions (MFIs) in Bangladesh using the stochastic frontier output distance function approach. Cobb-Douglas specification is applied with two outputs and four inputs for the period 2003-2011. Analysis reveals that on an average the rate of total factor productivity (TFP) growth in MFIs was 2.6%, mostly due to technological progress (2.5%), while the average efficiency change was only 0.1%. The mean efficiency of microfinance firms was 0.765, which implies that MFIs could have produced 23.5% more with the current levels of input bundles if they had been fully efficient. The determinants of firms' inefficiencies are cost per borrower and operational self-sufficiency, significant at the 1% level. The smaller MFIs (RDRS, Shakti, SSS, and JCF) define better frontiers than others, while bigger MFIs (BRAC, ASA, and GB) have been catching up faster than others.

Key words: Stochastic frontier output distance, total factor productivity (TFP), microfinance institutions (MFIs)

JEL Code: G21, Q140, Q120

*The author is Research Fellow of Centre for Policy Dialogue (CPD), Dhaka. Correspondence to: subirkanti105@gmail.com. The author is solely responsible for the facts, figures, and ideas expressed in this paper. This paper is prepared for the North American Productivity Workshop VIII June 4-7, 2014. Ottawa.

I. INTRODUCTION

The birth of Microfinance Institutions (MFIs) was in Bangladesh about three decades ago and over time it has been spreading to Asian, African, and Latin American countries. MFIs act as financial intermediaries, and their sources of funds are donor aid, loans from commercial banks and Palli Karma-Sahayak Foundation (PKSF), client savings, and their own cumulative surplus (MRA, 2010). MFIs provide microcredit to poor people without collateral and collect this loan along with interest in installments. The goals of MFIs are quite different from those of traditional financial institutions, that is, commercial banks and credit unions. Originally, they had two broad goals, (i) to earn revenue to cover operating and financial expenses known as the ‘institutionist paradigm’ (Woller et al., 1999; Murdoch, 2000), and (ii) to attain social goals, including poverty alleviation, known as the ‘welfarists paradigm’ (Haq *et al.*, 2010). Attaining these goals, an MFI must operate efficiently (Brau and Woller, 2004). However, the activities of MFIs have been criticized, particularly because of the charging excessive interest rates¹. The interest rates among MFIs in Bangladesh vary widely (table A.1) as do the number and amount of the loan installments. The determinants of interest rates are cost of funds, administrative expenses, loan losses, and desired capitalization rate (Write and Alamgir, 2004). The CGAP (2006) study found that the pricing decision of MFIs depends on quality service, competitive locations, flexible product characteristics, and product add-ons.² The products of microfinance organizations used to be homogeneous but now they produce differentiated products³. Some MFIs have even started to sell IPOs (initial public offerings) in the open market.⁴ Dr. Muhammad Yunus defined them as ‘new users’ and “loan sharks” who are moving away from their main goals (Yunus, 2011). These MFIs may depart from their original objectives due to high risk and uncertainty are associated with microcredit activities as well as significantly decrease in donor funds (from 40% of the funds in 1996 to 3.82% in 2011 (Pine, 2010; MRA,

¹ Based on the commercial MFIs in 73 countries, Assefa et al. (2013) found that the MFIs enjoy some level of market power that enables them to earn profit (charge interest rate above marginal cost).

² MFIs may introduce other types of loan (i.e. housing loan, education loan) or other financial services (i.e. savings or insurance linked to the loan).

³ Microcredit for small-scale self-employment based activities, microenterprise loans, loans for the ultra poor, agricultural loans, seasonal loans, and loans for disaster management.

⁴ SKS in India and Compartamos in Mexico have started to sell their IPOs.

2011)). In Bangladesh, the current government has been trying to intervene in the microfinance market that might not be able to solve this problem. The state government of Andhra Pradesh in India passed a law to protect poor people whereby borrowers need not repay their small-scale loan, which caused much turmoil in the area of microfinance (Banerjee, 2010).

Whether the microcredit programs of MFIs have a positive impact on society is debatable. Banerjee *et al.* (2009) found that access to microcredit in India does have a positive impact on the consumption of durable goods, but no impact on measures of health, education, or women's decision-making. In Bangladesh, the microcredit programs of MFIs have had a positive impact on the society as a whole, helping the poor out of poverty by generating employment and increasing household income (Hossain, 1984 and 1988; BIDS, 1990; World Bank, 1999). Agricultural and nonagricultural investment, human capital, and fixed capital investment have increased (PKSF, 2010). The empowerment of women has been enhanced (Amin, et al., 1998), as women are the beneficiaries of most programs (more than 80%). Wadud (2013) found that microcredit positively affects and helps strengthen food security. Comparing microcredit receivers and non-receivers, he also showed that receivers earn more than non-receivers.

The coverage of MFIs has expanded significantly, and nowadays, the activities of MFIs can be found in almost every corner of Bangladesh. However, some are of the opinion that microcredit programs make poor people poorer. The current government has been trying to publicize the Grameen Bank (GB), the country's largest microcredit lender, which charges the lowest interest rate among MFIs in the market. The government of Bangladesh used to provide subsidized agricultural/rural credit to poor farmers through specialized state-owned banks;⁵ however, default rates were very high and over the years the government would waive all defaulted loans.

Such perverse incentives are not good for any organization's long-term sustainability. The loan recovery rate of MFIs is over 95 percent, which involves significant administrative expenses.

⁵ Bangladesh Agricultural Bank and Rajshahi Agricultural Development Bank

The risks of providing loans are also high as MFIs do not know the private information⁶ of poor people. As a result, MFIs have two options, which are to increase interest rates and fees to recover expenses or to promote market-based services to sustain them in the long run (Rauf and Mahamood, 2009). Some microfinance organizations may be more efficient and technically developed than others so they may charge lower interests. My purpose, therefore, is to estimate the inefficiency and productivity of 10 major MFIs between 2003 and 2011 in Bangladesh.

A significant number of studies have been conducted to examine the performance of financial institutions (banks, credit unions) but not many on microfinance institutions. In 1997, Berger and Humphrey surveyed 130 studies that estimated the efficiency of financial institutions in 21 countries. Interest in the area of microfinance since 2000 has been increased may be due to the realization that microfinance institutions are important to the economy and to the development of a very rigorous dataset by MIX Market. A short review of the available literature related to the efficiency analysis of MFIs is presented in the Appendix Table A.3. Twelve studies out of eighteen used nonparametric analysis (data envelope analysis, index number approaches) to examine the performance of MFIs. In the remaining studies, nobody used stochastic frontier distance function specification. In this study, I used a parametric method (stochastic frontier distance function) to estimate the efficiency and productivity of major microfinance institutions in Bangladesh. The results show productivity grew an average of 2.6 percent during the period 2003 to 2011, largely due to technological progress (2.5 percent).

This paper is organized into four sections. Following the introduction section, Section II presents an overview of microfinance institutions in Bangladesh. Section III describes the inputs and outputs selection procedures and their characteristics and the methods of measuring the efficiency and productivity of MFIs in Bangladesh. Section IV presents the results of empirical estimation, and conclusions are drawn in the final section.

⁶ Microcredit borrowers are taking multiple loans from different microfinance sources at the same time. A survey in 2000 shows that about 12.6% of borrowers in Bangladesh were found to be participating in multiple MFIs (Zohir, 2011); loan use might be completely different from the loan objective i.e. a loan for buying a goat or cow might be spent on durable goods. If this is so, then providing loans to this group would be more risky.

II. OVERVIEW OF MICROFINANCE INSTITUTIONS IN BANGLADESH

More than 1200 microfinance institutions (MFIs) operate in Bangladesh (CDF, 2005). These organizations can be categorized into four groups: (i) the Grameen Bank (GB); (ii) private microfinance institutions (NGO-MFIs); (iii) commercial and specialized banks; and (iv) the microfinance program of the Bangladesh Rural Development Board (BRDB), cooperative societies, and agencies sponsored by the government (MRA, 2010). The Grameen Bank and nine other NGO-MFIs (ASA, BRAC, BURO Bangladesh, JCF, RDRS, Shakti, SSS, TMSS, and UDDIPAN⁷) capture more than two thirds of market share (averaged 2009-2011).⁸ GB alone captures 30% and two giant microfinance institutions, BRAC and ASA, together capture another 35% of market share. A brief introduction to GB, ASA, and BRAC (three big sharks) is given below:

Grameen Bank (GB)-Bank for the Poor

The Grameen Bank is the pioneer microcredit institution in Bangladesh, jointly established in 1979 by Professor Muhammad Yunus and the then government after achieving positive results from the demonstrated action research project of 1976-1979. Today, GB borrowers own 90 percent of its share and the rest is owned by the government. The main objectives of the GB are to extend banking facilities to rural men and women and to eliminate the exploitation of poor people by money lenders. It provides credit to the poorest people of Bangladesh without any collateral fee. The GB's coverage area is about 97% of all villages in Bangladesh. It has more than 8 million borrowers (97% of them are women) and serves them from its 2,565 branches.⁹ The GB provides the poor with micro-enterprise loans, housing loans, higher education loans, loan insurance, life insurance, and village phones. In 2006, this organization won the Nobel Peace Prize for its contributions to the social and economic development of Bangladesh. GB is

⁷ ASA = Association for Social Advancement; BRAC = Bangladesh Rural Advancement Committee, GB = Grameen Bank; JCF = Jagoroni Chakra Foundation; RDRS = Rangpur Dinajpur Rural Service; TMSS = Thengamara Mohila Sabuj Sangha; Shakti = Shakti Foundation for Disadvantaged Women; SSS = Society for Social Service; UDDIPAN = United Development Initiatives for Programmed Actions.

⁸ Market share has been estimated according to the number of active borrowers. This holds even if the amount of loan outstanding or amount of savings is considered.

⁹ For those interested in knowing more about GB, please visit its website: <http://www.grameen.com/>

the only one organization that charges lowest interest rates in Bangladesh (table A.2). Bairagi and Azzam (2014) found that GB's market is about 3% above marginal cost.

BRAC (Bangladesh Rural Advancement Committee)

BRAC is a nongovernmental development organization founded by Sir Fazle Hasan Abed, won 2015 World Food Prize, immediately after the independence of Bangladesh in 1972. Currently BRAC has a presence in all districts of Bangladesh as well as in other parts of Asia (Afghanistan, Pakistan, the Philippines, and Sri Lanka), Africa (Liberia, Sierra Leone, South Sudan, Tanzania, and Uganda), and the Americas (Haiti). Its mission is "to empower people and communities in situations of poverty, illiteracy, disease and social injustice".¹⁰ BRAC has about 6 million microfinance borrowers and controls about 22 percent of market share in the microfinance sector. In addition to its microfinance operation, BRAC has 15 other programs, including agriculture and food security, education, public health, social development, disaster relief, and ICT development, worldwide. BRAC's interest rates are higher than the interest rates charged by GB (table A.2).

ASA (Association for Social Advancement)

ASA is a nongovernmental development organization in Bangladesh, established in 1978. The objectives of ASA are to "alleviate poverty and improve the quality of lives of the landless and assetless rural poor by providing them with access to financial services".¹¹ It offers both financial (loans, savings, insurance, foreign remittance services) and nonfinancial services (health and education). In 2007, ASAI (ASA INTERNATIONAL) was born and started to extend its range to India, Pakistan, Sri Lanka, Ghana, the Philippines, Afghanistan, Cambodia, and Nigeria with a view to empowering the poorest and most deprived populations of the world. The total number of ASA borrowers is about 4.5 million.

¹⁰ <http://www.brac.net/content/who-we-are-mission-vision#.UZzt-6LVCS0>

¹¹ http://asa.org.bd/?page_id=29

II. METHOD AND DATA

II.1 Stochastic Frontier Distance Function Approach (SFDA)

The following section is adapted from Coelli and Perelman (1996) and O'Donnell and Coelli (2003). In this study, the following functional form for the distance function has been used as it is flexible and easy to estimate (Coelli and Perelman, 1996). The functional form of Cobb-Douglas output distance technology for M outputs and N inputs can be specified as

$$\ln D_{Oi} = \alpha_0 + \sum_{m=1}^M \alpha_m \ln y_{mi} + \sum_{n=1}^N \beta_n \ln x_{ni} + v_i \dots \dots \dots (2.2.1),$$

where y_{mi} is the vector of outputs produced by firm i ; x_{ni} is the vector of inputs used by firm i to produce y_{mi} . v_i is a random variable introduced into the equation to capture the approximation errors and statistical noise. This function is nondecreasing in y and nonincreasing in x , linearly homogenous in y , convex in y , and quasi-convex in x .

In the previous model, it is impossible to observe dependent variables. Therefore, homogeneity in outputs restriction can be imposed, and the model (2.2.1) can be fit econometrically. The homogeneity condition implies that

$$D_{Oi}(x, \lambda y) = \lambda D_{Oi}(x, y).$$

Here, if one output such as y_M is chosen arbitrarily and set $\lambda = 1/y_M$, we will have

$$D_{Oi}(x, y/y_M) = \frac{D_{Oi}(x, y)}{y_M}.$$

For equation 2.2.1, this will provide

$$\ln(D_{Oi}/y_M) = \alpha_0 + \sum_{m=1}^{M-1} \alpha_m \ln (y_{mi}/y_M) + \sum_{n=1}^N \beta_n \ln x_{ni} + v_i \dots \dots \dots (2.2.2).$$

In equation 2.2.2, the expression of the second term on the right is $M-1$ instead of M because when $y_m = y_M$, the ratio is equal to one and the log of this ratio is zero. Rearranging equation 2.2.2, we get

$$-\ln y_M = \alpha_0 + \sum_{m=1}^{M-1} \alpha_m \ln (y_{mi}/y_M) + \sum_{n=1}^N \beta_n \ln x_{ni} + v_i - \ln D_{Oi} \dots \dots \dots (2.2.3).$$

Equation 2.2.3 can be estimated by applying the stochastic frontier approach proposed by Aigner, Lovell, and Schmidt (1977), which involves two error terms: a symmetric error, v_i , associated with noise and an asymmetric error, u_i , associated with technical inefficiency. Thus, we get the following output distance function:

$$-\ln y_M = \alpha_0 + \sum_{m=1}^{M-1} \alpha_m \ln (y_{mi}/y_M) + \sum_{n=1}^N \beta_n \ln x_{ni} + v_i + u_i \dots \dots \dots (2.2.4),$$

where $-\ln D_{Oi} = u_i \Rightarrow D_{Oi} = e^{-u_i} \Rightarrow TE_i = \exp(-u_i)$ - is the technical efficiency of the i -th firm's production.

The parameters of equation 2.2.4 can be estimated with appropriate distributional assumptions of v_i and u_i . Regarding this, the specification by Battese & Coelli (1995) was followed. The random variables, v_i , are $iid \sim N(0, \sigma_v^2)$ and independently distributed of u_i . The random variables, u_i , are assumed to be non-negative and responsible for technical inefficiency in production and are independently distributed as truncations at zero the distribution with nonzero mean, $iid \sim N(\mu, \sigma_u^2)$.

In estimating unknown parameters, the maximum likelihood (ML) method was applied. The package 'frontier' by Coelli and Henningsen (2013) in software R version 2.15.2 was used to estimate unknown parameters and the output distance predictions.

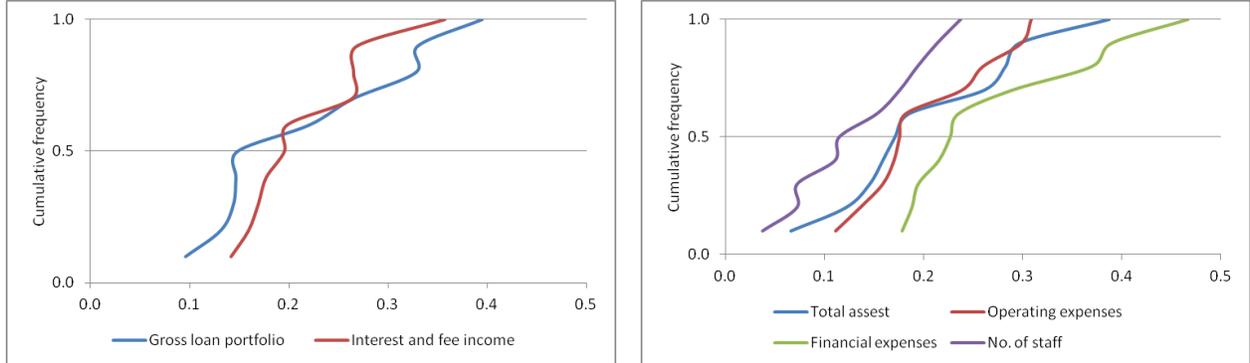
II.2 Data: Inputs and Outputs Selection

Outputs of financial institutions can be measured in two ways, which are the 'production approach' and the 'intermediation approach' (Berger and Humphrey, 1997). In the first approach, financial institutions are thought of as producers, while in the second approach, institutions are thought of as intermediaries. In the case of NGO-MFIs in Bangladesh, about 38% of their funds come from loans and the rest from clients' savings and cumulative surpluses. In the first case, MFIs in Bangladesh can be thought of as financial intermediaries, while in the

second case, MFIs can be thought of as producers. In this study, the production approach has been applied to select outputs and inputs to estimate the efficiency of 10 major microfinance institutions in Bangladesh. Two outputs (gross loan portfolio and interest and fee income), four inputs (total assets, operating expenses, financial expenses, and number of staff), and five efficiency variable were used. Data for each of these MFIs were gathered from the MIX Market covering the period 2003-2011. The definition and descriptive statistics of these variables are provided in the Appendix Tables A.4 and A.5.

The average annual growth rates of outputs and inputs are presented in Figure 2.2.1. The median growth of gross loan portfolio is about 0.18; five microfinance institutions (JCF, SSS, UDDIPAN, BURO, and TMSS) are above median growth, and the other five are below median growth. The median growth of interest and fee income is about 0.20. In this case, microfinance institutions that are above median growth are the same as gross loan portfolio, except TMSS. The growth patterns for both outputs are almost similar. Figure 2.2.2 reveals that the growth rates of financial expenses have been higher than other inputs.

Figure 2.2.1 Annual average growth rates (%) of outputs (left panel) and inputs (right panel), 2003-2011



Source: Author’s estimation based on data gathered from MIX Market (2013)

III. RESULTS AND DISCUSSIONS

Two empirical models have been estimated which can be rewritten from the equation 2.2.4 as follows:

$$-\ln y_{1it} = \alpha_0 + \alpha_1 \ln(y_{2it}/y_{1it}) + \beta_1 \ln x_{1it} + \beta_1 \ln x_{2it} + \beta_1 \ln x_{3it} + \beta_1 \ln x_{4it} + \beta_5 T + \varepsilon_{it}, \quad i = 1, 2, \dots, 10, \dots \dots \dots (3.1)$$

$$-\ln y_{1it} = \alpha_0 + \alpha_1 \ln(y_{2it}/y_{1it}) + \beta_1 \ln x_{1it} + \beta_1 \ln x_{2it} + \beta_1 \ln x_{3it} + \beta_1 \ln x_{4it} + \beta_5 T + \sum_{l=2}^{10} \gamma_l DF_{il} + \varepsilon_{it} \dots \dots \dots (3.2)$$

y_i and x_i , are described in the Appendix Table A.3. T is the time period that is considered to capture the technological change. DF_{il} are firm dummies, where $l = 2, \dots, 10$. The distribution of error terms, ε_i , is described in the methodology section. In addition, some inefficiency parameters, z_i , are included in the model.

$$u_i = \delta_0 + \sum_{z=1}^5 \delta_z Z_{zi} \dots \dots \dots (3.3)$$

The estimated coefficients from the previous two models are presented in Table 3.1. To compare two frontier models, a likelihood ratio test was conducted that shows the Chi-square statistic (85.21) is statistically significant at the 1% level, confirming that additional variables are needed in the model. Thus the second functional specification is chosen for estimating firm-specific efficiency because most of the firm dummies used are significant, which also clearly reveals that microfinance institutions are heterogeneous. Table 3.1 shows that the signs of all parameters estimated from the previous two equations are expected and agree with each other. Note that signs on the left in the equations 3.1 and 3.2 are negative so when we read Table 3.1 signs will be the other way around. For example, if total assets increase 10% then gross loan portfolio will increase 4.74%. The results reveal that if the costs of microfinance institutions increase (operating expenses, financial expenses, number of staff) then gross loan

portfolios will increase, which makes sense because MFIs are required to increase gross portfolio to recover expenses. Total assets and operating expenses are significant at the 1% level and correlate positively with gross loan portfolio. Conversely, the coefficient of ratio of interest and fee income to gross portfolio is significant at the 1% level and correlates negatively with gross loan portfolio. The coefficient of time reveals the technological progress/regress of MFIs. The result shows that the technological growth of MFIs was 2.5 percent during the period 2003-2011, which is statistically significant at the 1% level.

The estimated mean efficiency of MFIs ranges between 0.769 and 0.847, which implies that firms do have options to increase their efficiency. In other words, firms can produce 15.3% to 23.1% more than existing levels with the current levels of input vectors. The estimated lambda value is large, which implies that total error variance is mainly due to inefficiency, while random errors are not important. In other words, the variance for efficiency is larger than the variance for random errors.

Table 3.1 also reveals that the signs of all the inefficiency parameters estimated from the two functional specifications are the same except for two inefficiency variables (percentage of female borrowers and loan loss rate). The operational self-sufficiency and cost per borrower are significant at the 1% level and negatively correlate with inefficiency. This suggests that if the cost per borrower and operational self-sufficiency increase, the firms' inefficiency will decrease. Thus, the firms' strategy should be to minimize cost per borrower; if so, the operational self-sufficiency would be bigger as it is defined as the share of financial revenue to the total expenses. The debt to equity is defined as the firms' liability in terms of capital (equity); a small share of liability to capital is expected. If the debt to equity ratio increases, the inefficiency of MFIs should increase; in this case, the first specification also gives the expected sign. Qayyum and Ahmad (2006) also found negative signs of this variable, though they used technical efficiency as a function of debt to equity along with other variables.

Table 3.1 Estimated coefficients from Cobb-Douglas stochastic distance function

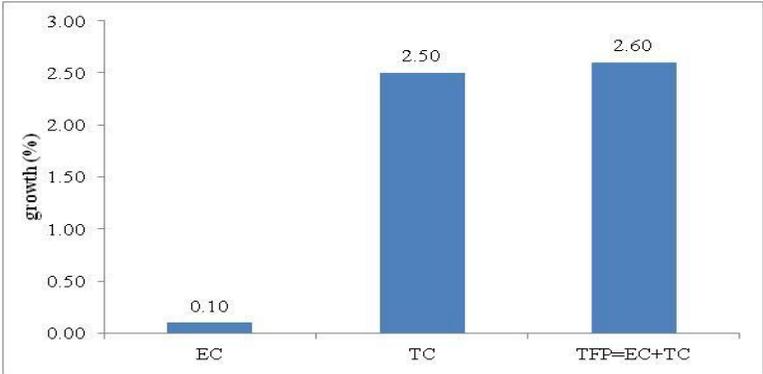
[Dependent variable: Gross loan portfolio]		Model 1		Model 2	
Variables		Coefficient	Standard Error	Coefficient	Standard Error
Independent variables					
Intercept	α_0	-0.508	0.742	-1.999***	0.744
Interest and fee income gross loan portfolio	α_1	0.516***	0.124	0.638***	0.068
Total assets	β_1	-0.466***	0.096	-0.474***	0.070
Operating expenses	β_2	-0.365***	0.120	-0.270***	0.069
Financial expenses	β_3	-0.111	0.069	-0.106**	0.042
Number of staff	β_4	-0.061	0.101	-0.040	0.048
Time	β_5	-0.012	0.013	-0.025***	0.009
FirmDummy2				-0.102*	0.055
FirmDummy3				0.242**	0.119
FirmDummy4				0.029	0.071
FirmDummy5				0.387**	0.156
FirmDummy6				0.429***	0.142
FirmDummy7				0.311*	0.142
FirmDummy8				0.417***	0.132
FirmDummy9				0.252**	0.105
FirmDummy10				0.404***	0.152
Inefficiency variables					
Intercept	δ_0	-0.294	0.548	-0.057	0.176
% of female borrowers	δ_1	0.125	0.805	-0.149	0.175
Operational self-sufficiency	δ_2	0.203*	0.113	0.258***	0.034
Cost per borrower	δ_3	0.020**	0.010	0.011***	0.003
Loan loss rate	δ_4	-0.002	0.993	0.200	0.337
Debt to equity ratio	δ_5	-0.036***	0.009	0.002	0.004
Sigma squared	σ^2 $= \sigma_v^2 + \sigma_u^2$	0.010***	0.002	0.003***	0.0005
Gamma	γ $= \frac{\sigma^2}{\sigma_v^2 + \sigma_u^2}$	0.825***	0.134	0.999***	0.008
Variance for inefficiency	σ_u^2	0.008		0.003	
Variance for random error	σ_v^2	0.002		0.00003	
Lambda	λ $= \sqrt{\sigma_u^2 / \sigma_v^2}$	2.171		9.950	
Mean efficiency		0.847		0.769	
Log likelihood		91.793		134.398	

Source: Author's estimation, 2013.

Note: '***', '**' and '*' indicate 1%, 5%, and 10% significance level.

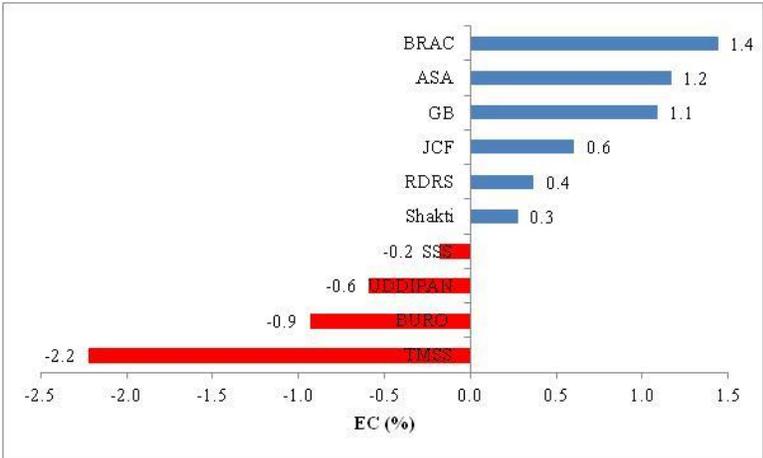
The total factor productivity (TFP) growth, efficiency change (EC), and technological change (TC) in major microfinance institutions in Bangladesh are shown in Figure 3.1. During the period 2003-2011, TFP grew at 2.6 percent, mostly due to technological progress (2.5 percent). During the same period, the rate of technical efficiency showed positive growth, but only 0.1%. Firm-specific changes in levels of efficiency show the efficiency growth of the three largest microfinance institutions (BRAC, ASA, and GB) was more than 1% between 2003 and 2011 (Figure 3.2). Three MFIs (JCF, RDRS, and Shakti) experienced positive growth ranging from 0.3% to 0.6%, while four MFIs experienced negative efficiency growth (SSS, UDDIPAN, BURO, and TMSS).

Figure 3.1 TFP growth (geometric mean) in MFIs of Bangladesh, 2003-2011



Source: Author's estimation, 2013

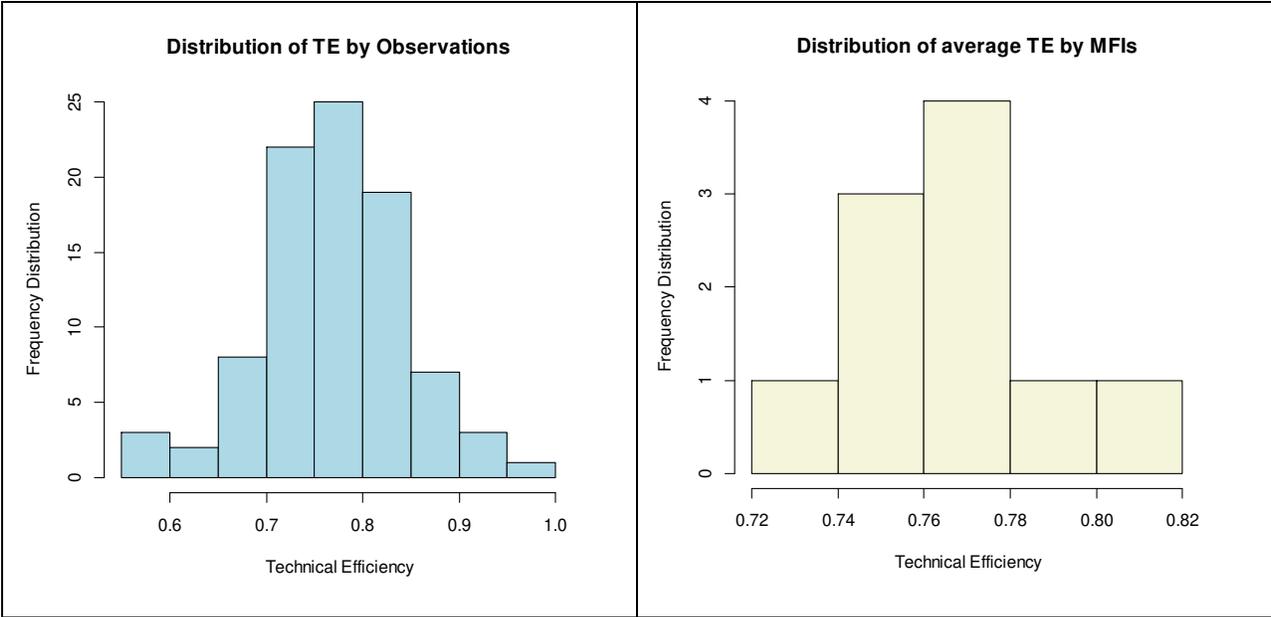
Figure 3.2 Efficiency change (EC) in MFIs of Bangladesh, 2004-2011



Source: Author's estimation, 2013

The distribution of efficiency scores by each observation as well as by microfinance firms is presented in Figure 3.3. The left panel shows that most of the points are far away from the fully efficient points; in other words, the points are not close to the production possibility frontier (PPF). This implies that these microfinance firms have never been on the frontier. If the average efficiency scores are distributed by firms, similar results are found. Only two microfinance firms (RDRS, efficiency score 0.793 and Shakti, efficiency score 0.816) are close to the PPF compared to other firms. Four firms (SSS followed by JCF, ASA, and BRAC) are close to the average efficiency score (0.765), while the other four firms (BURO, GB, TMSS, and UDDIPAN) are below the average efficiency score. Note that the range of average technical efficiency scores is between 0.724 and 0.816. Based on the efficiency ranking (Appendix Figure A.2), it can be inferred that smaller microfinance institutions, with the exceptions of TMSS and UDDIPAN, define better frontiers than bigger microfinance institutions.

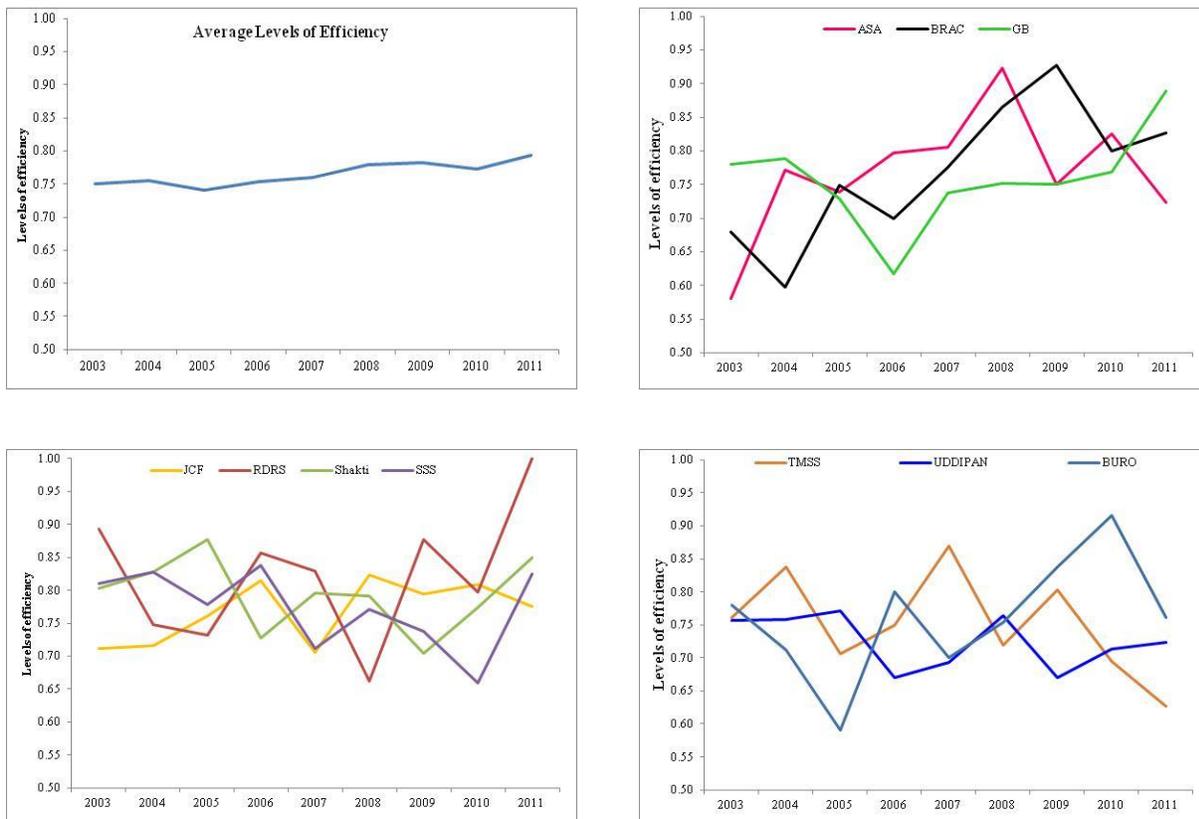
Figure 3.3 Frequency distribution of levels of TE by observations (left panel) and by MFIs (right panel)



Source: Author's estimation (2013)

The average and firm-specific evolutions of the levels of technical efficiencies are presented in Figure 3.4, which reveals no microfinance institutions were on the frontier in the period 2003 to 2011. Only one organization, RDRS, reached full efficiency (on the frontier) in 2011. This organization currently works in 16 northern districts of Bangladesh. RDRS became an autonomous national NGO in 1997, though it was established by the Lutheran World Federation/Department for World Service in 1972 to assist the population of the Rangpur and Dinajpur areas with relief and rehabilitation immediately after the War of Independence.¹² Figure 3.3 shows that the evolutions of the levels of technical efficiencies of all bigger microfinance institutions were trending upward. This implies that these firms were catching up to the best technology frontiers faster than others. The evolutions of the levels of technical efficiencies of small microfinance institutions were static in the period 2003-2011.

Figure 3.4 Evolution of the levels of efficiencies of MFIs in Bangladesh



Source: Author's estimation, 2013

¹² <http://www.rdrsbangla.net/Page.php?pageId=MTU1NA==>

IV. CONCLUSIONS

This paper used the parametric approach (Stochastic frontier distance function) to estimate the inefficiency and productivity of 10 major MFIs in Bangladesh. Gross loan portfolio and interest and fee income were considered as outputs, while total assets, operating expenses, financial expenses, and number of staff were used as inputs. Data were collected from MIX Market. The data covers the period from 2003 to 2011. To capture technological change, a time trend was added in the distance function. Five efficiency variables, operational self-sufficiency, loan loss rate, debt to equity ratio, cost per borrower, and percentage of female borrowers, were also included to capture the firms' inefficiencies. The results show that on an average the rate of TFP growth in MFIs was 2.6% during the period 2003-2011, mostly due to technological progress (2.5%).

The estimated mean efficiency was 0.765, which implies that firms could have produced 23.1% more than the existing levels with their current levels of input bundles if they had been fully efficient. The determinants of the firms' inefficiencies were cost per borrower and operational self-sufficiency, which were significant at the 1% level. The estimated lamda value was large, meaning that total error variance was mainly due to inefficiency, while random errors were not important. The ranking of firm-specific average technical efficiencies revealed that smaller microfinance institutions (RDRS, Shakti, SSS, and JCF) defined better frontiers than others. The firm-specific evolutions of the levels of technical efficiencies showed bigger MFIs (BRAC, ASA, and GB) were catching up to the best frontiers faster than other microfinance institutions.

REFERENCES

- Aigner, D.J., Lovell, C.A.K., and Schmidt, P. (1977) 'Formulation and Estimation of Stochastic Frontier Production Function Models', *Journal of Econometrics* 6: 21-37.
- Bairagi, S. and Azzam, A. (2014) 'Does the Grameen Bank Exert Market Power over Borrowers', *Applied Economics Letters*, Vol. 21(12): 866-869.
- Banerjee, A., Bardhan, P., Duflo, E., Field, E., Karlan, D., Khwaja, A., Mookherjee, D., Pande, R. and Rajan, R. (2010) 'Microcredit is not the Enemy', *Financial Times*, December 13.
- Banerjee, A., Duflo, E., Glennerster, R. and Kinnan, C. (2013) *The Miracle of Microfinance? Evidence from a Randomized Evaluation*. USA: NBER Working Paper 5/13.
- Bassem, B.S. (2008) 'Efficiency of Microfinance Institutions in the Mediterranean: An Application of DEA', *Transition studies review, Mediterranean and Middle East Papers* 15(2): 343-354.
- Battese, G.E. and Coelli, T.J. (1988) 'Prediction of Firm-Level Technical Efficiencies with a Generalised Frontier Production Function and Panel Data', *Journal of Econometrics* 38: 387-399.
- Battese, G.E. and Coelli, T. (1995) 'A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data', *Empirical Economics* 20: 325-332.
- Ben Abdelkader, I., Hathroubi, S. and Ben Jemaa, M.M. (2012) *Microfinance Institutions' Efficiency in the MENA region: A Bootstrap-DEA approach* ECONSTOR. Available at: <http://econstor.eu/bitstream/10419/69525/1/ISMEconstor.pdf>
- Bolli, T. and Vo Thi, A. (2012) *On the Estimation Stability of Efficiency and Economies of Scale in Microfinance Institutions*, Zurich: KOF Working Papers 1/12.
- Brau, J. C. and Woller, G. M. (2004) 'Microfinance: A Comprehensive Review of the Existing Literature', *Journal of Entrepreneurial Finance and Business Ventures* 9: 1–26.
- BURO Bangladesh (2012) *Annual Report 2011-2012*. Dhaka: BURO Bangladesh.
- Caves, D.W., Christensen, L. R. and Diewert, W. E. (1983) 'The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity', *Econometrica* 50(6): 1393-1414.

- CDF (2005) *Microfinance Statistics Vol.17*. Dhaka: Credit and Development Forum (CDF).
- CGAP (2006) *Competition and Microcredit Interest Rates*. Focus Note, 33/06. The Consultative Group to Assist the Poor (CGAP).
- Coelli, T. J. (1996) *A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation*. Australia: The University of England, Center for Efficiency and Productivity Analysis (CEPA) Working Paper Series, No. 7/96.
- Coelli, T. and Perelman, S. (1996) *Efficiency Measurement, Multiple-Output Technologies and Distance Functions: With Application to European Railways*. Belgium: Université de Liège, CREPP Working Paper 5/96.
- Coelli, T.J., Rao, D.S.P. and O'Donnell, C.J. (1998) *An Introduction to Efficiency and Productivity Analysis*, 2nd edn. New York: Springer Publishing.
- Farrel, M. (1957) 'The Measurement of Productive Efficiency', *Journal of Royal Statistical Society* 120(3): 253-2811.
- Gebremichael, B.Z. (2012) 'Total Factor Productivity Change of Ethiopian Microfinance Institutions (MFIs): A Malmquist Productivity Index Approach (MPI)' *European Journal of Business and Management* Vol. 4(3): 105-114.
- Gutiérrez-Nieto, B., Serrano-Cinca, C. and Molinero, M. (2009) 'Social Efficiency in Microfinance Institutions', *Journal of the Operational Research Society* 60: 104-119.
- Gutiérrez-Nieto, B., Serrano-Cinca, C. and Molinero, M. (2007) 'Microfinance Institution and Efficiency' *The international journal of Management Science* 35: 131-142.
- Haq, M., Skully, M. and Pathan, S. (2010) 'Efficiency of Microfinance Institutions: A Data Envelopment Analysis', *Journal Asia-Pacific Finance Markets* 17:63–97.
- Hartarska, V. and Mersland, R. (2012) 'Which Governance Mechanisms Promote Efficiency in Reaching Poor Clients? Evidence from Rated Microfinance Institutions', *European Financial Management* 18(2): 218–239.
- Hassan, M.K. and Benito, S. (2009) *Efficiency Analysis of Microfinance Institutions in Developing Countries*. USA: Networks Financial Institute (NFI), Indiana State University Working Paper, 12/09.

- Hossain, M. (1984) *Credit for the Rural Poor: The Grameen Bank in Bangladesh*. Monograph 4. Dhaka: Bangladesh Institute of Development Studies (BIDS).
- Hossain, M. (1988) *Credit for Alleviation of Rural Poverty: The Grameen Bank in Bangladesh*. Bangladesh: International Food Policy Research Institute (IFPRI) and Bangladesh Institute of Development Studies (BIDS). Research Report, 65/88.
- Jondrow, J., Lovell, C.A.K., Materov, I.S. and Schmidt, P. (1982) 'On Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model' *Journal of Econometrics* 19: 233-238.
- Mahmud, W. and Khalily, M. (2008) *Bangladesh Microfinance Statistics 2007*. Bangladesh: Institute of Microfinance.
- Malmquist, S. (1953) 'Index numbers and indifference surfaces', *Trabajos de Estadística* 4: 209-242.
- Martínez-González, A. (2008) *Technical Efficiency of Microfinance Institutions: Evidence from Mexico*, MS Thesis, The Ohio State University.
- Masood, T. and Ahmad, M.I. (2010) *Technical Efficiency of Microfinance Institutions in India- A Stochastic Frontier Approach*. Munich Personal RePEc Archive (MPRA). [online] Available at: http://mpa.ub.uni-muenchen.de/25454/1/MPRA_paper_25454.pdf.
- Mixmarket (2013) *The Microfinance Information eXchange (MIX)*. Available at: <http://www.mixmarket.org/en/what.is.mix.asp>.
- Morduch J. (1999a) 'The Microfinance Promise', *Journal of Economic Literature* 37: 1569-1614.
- Morduch. J. (1999b) 'The role of Subsidies in Microfinance: Evidence from the Grameen Bank', *Journal of Development Economics* 60: 22-248.
- MRA (2011) *NGO-MFIs in Bangladesh: A Statistical Publication, Volume, VIII*. Dhaka: Microcredit Regulatory Authority (MRA).
- Murdoch, J. (2000) 'The Microfinance Schism', *World Development* 28: 617-629.
- Nawaz, A. (2010) *Efficiency and Productivity of Microfinance: Incorporating the Role of Subsidies*. Brussels: School of Economics and Management, Centre Emile Bernheim (CEB) Working Paper, 10/00.

- Nghiem, H., Coelli, T. and Rao, D. S. P. (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(5): 71-78.
- O'Donnell, C. and Coelli, T. (2003) *A Bayesian Approach to Imposing Curvature on Distance Functions*. Australia: School of Economics University of Queensland, Centre for Efficiency and Productivity Analysis (CEPA) Working Paper 3/03.
- Pine, D. (2010) *The Microfinance Sector in Bangladesh: Innovation or Stagnation*. Center for Microfinance Thesis Series, No. 6. University of Zurich.
- PKSF (2010) *Annual Report 2010*. Dhaka: Palli Karma-Sahayak Foundation (PKSF).
- Qayyum, A. and Ahmad, M. (2006) *Efficiency and Sustainability of Micro Finance*. MPRA Paper 11674/10.
- Rauf, S. A. and Mahamood, T. (2009) 'Growth and Performance of Microfinance in Pakistan', *Pakistan Economic and Social Review* 47(1): 99-122.
- Wadud, M. A. (2013) *Impact of Microcredit on Agricultural Farm Performance and Food Security in Bangladesh*. Dhaka: Institute of Microfinance (InM), Working Paper 14/13.
- Woller, G., Dunford, C. and Woodworth, W. (1999) 'Where to Microfinance', *International Journal of Economic Development*, 1: 29–64.
- Wright, D. and Alamgir, D. (2004) 'Microcredit Interest Rates in Bangladesh 'Capping Vs Competition'. Donors' Local Consultative Group on Finance.
- Yunus, M. (2011) 'Sacrificing Microcredit for Megaprofits', *New York Times op-ed*, January 14, 2011.

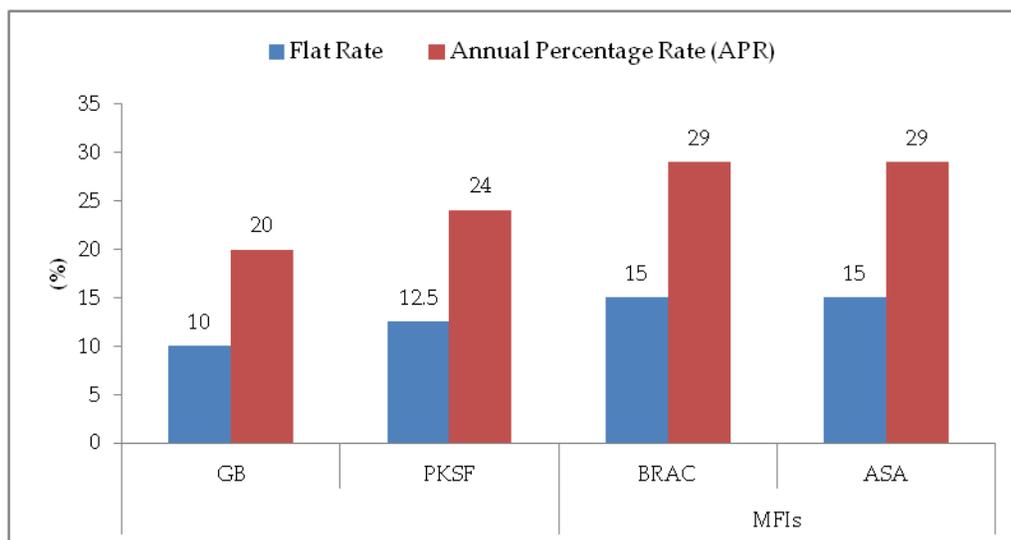
APPENDIX

Table A.1 Distribution of the interest rate (flat rate)

Interest rates	Number of MFIs	% of total MFIs
2-5	0	0.00
5-8	3	0.56
8-11	3	0.56
11-12.5	18	3.36
12.5	180	33.6
12.5-15	3	0.56
15	309	57.8
15-20	2	0.37
20	5	0.93
Above 20	0	0.00
Total	508	100.0

Source: Mahmud and Khalily (2008)

Figure A.2 Flat rate and annual percentage rate (APR) of largest MFIs in Bangladesh



Source: For GB, Grameen Bank Year End Update: December, 2010; For PKSF to POs, Annual Report 2010 by PKSF; For BRAC and ASA, Write and Alamgir (2004)

Table A.3 Recent studies related to microfinance institutions

Approaches	Country/Countries	Data period	Outputs	Inputs	Results	Author
Data Envelopment Analysis (DEA)	Pakistan	2003-2007; Pakistan Microfinance Network	Gross Loan Portfolio and Number of Active Borrowers	Total Assets and Number of Personnel	Mean efficiency: 0.571- 0.717	Ahmad (2011)
DEA (CCR and BBC)	Mediterranean zone (35 institutions)	2004-2005, MIX Market	Number of women and ROA (return on assets)	Number of employees (staff), total amount of assets	Eight institutions are efficient. Medium institutions are more efficient	Bassem (2008)
Bootstrap- DEA	MENA region	2006-2009	Financial revenue, indicator of benefit to the poorest	Total assets, operating expenses, number of employee	Average efficiency of most countries of the MENA region has Decreased	Ben Abdelkader, et al. (2012)
DEA, SFA,	Surveyed 130 studies in 21 countries that applied frontier efficiency	Production and Intermediation approaches			They found that various efficiency methods do not necessarily provide consistent results	Berger and Humphrey (1997)
DEA, DFA (distribution -free approach), and SFA	796 microfinance institutions (MFI) across 88 countries in 6 regions	2005-2009	Gross loan portfolio; Inverse of the average loan balance per borrower per GNI	Personnel and total borrowings. Operating expenses per personnel and financial expenses per total borrowings	Rankings of MFIs' efficiency were found to robust across identification strategies	Bolli and Vo Thi (2012)
Index number approach (Malmquist)	Ethiopia	2004-2009	Interests and fee income, gross loan portfolio, and number of loans outstanding	Number of employees and operating expenses	Productivity grew at 3.8% annually which is due to the progress of technical efficiency	Gebremichael (2012)
DEA	To estimate social efficiency for 89 MFIs. Microfinance Information eXchange (MIX)	2003	1. Number of active women borrowers 2. Indicator of benefit to the poor 3. Gross loan portfolio(GLP)	1. Total assets 2. Operating costs 3. Number of Employees	The analysis showed that there is a positive but low correlation between social efficiency and financial efficiency	Gutiérrez- Nieto et al. (2009)

			4. Financial revenue			
DEA	39 microfinance Institutions across Africa, Asia, and Latin America	2004 MIX Market	1. Number of borrowers per staff 2. Number of savers per staff member 1. Gross loan portfolio 2.Total savings	Production approach: 1. Labor 2. Cost per borrower 3. Cost per saver Intermediation approach: 1. Total number of stuffs 2. Operating/ administrative expenses	NGO-MFIs are the most efficient under the production approach, however, under intermediation approach bank-microfinance institutions outperform in the measure of efficiency	Haq et al. (2010)
Stochastic Cost Frontier	155 MFIs from 45 countries	2000-2007 www.ratingfund2.org/	Number of borrowers	Labor (employee), physical capital (operating expenses – personnel expenses divided by fixed assets), and financial capital	“Efficiency increases with a board size of up to nine members and decreases after that”	Hartarska and Mersland (2012)
Malmquist index	Latin American countries, Middle East and North African (MENA) countries, and South Asian countries	MIX Market, 2002-2005	Gross Loan Portfolio, Total Funds, Financial Revenue, Number of Active Borrowers	Financial expenses, operating expenses, loan loss provision expense, and labor	South Asian MFIs have higher efficiencies than their counterparts in Latin America and MENA countries	Hassan and Benito (2009)
Stochastic frontier cost function	Grameen Bank, Bangladesh	1998-91	Loans, savings, and members	Labor and capital and their prices	Average inefficiency score for GB was found from 3-6%	Hassan and Tuftte (2001)
DEA, Tobit regression	West African Economic and Monetary Union (Benin, Burkina Faso, Côte d’Ivoire, Mali, Niger, Senegal, and Togo)	2002-2006	For financial efficiency Gross Loan Portfolio For social efficiency number of active borrowers, Index of Poverty, percent of women borrowers	Financial efficiency Financial Expenditure, equity, PERS For social efficiency Financial Expenditure, Equity as capital, number of the MFIs’ workers	Sustainability prevails	Kablan (2012)
DEA, Tobit Regression	Mexico	Survey data. Data period: 2003-2007	Production: number of clients Intermediation approach: outstanding loan portfolio	Total number of employees, administrative and marketing expenses	most MFIs have been more efficient in pursuing sustainability (proxied by the	Martínez-González, A., 2008

				minus the total payroll, equity plus liabilities	performing loan portfolio size)	
SFA	40 MFIs in India	2005-2008	Gross loan portfolio,	number of staff members, cost per borrower	mean efficiency of microfinance institutions is 0.34	Masood and Ahmad (2010)
DEA, Malmquist index and Tobit Regression	World wide	2005-2006	Gross loan portfolio, financial revenue, total subsidies (if it is positive)	Total assets, operating costs, number of staff, total subsidies (if it is negative)	"MFIs which cater to the poor tend to be more inefficient than those with clients relatively well off". "Lending to women is efficient only in the presence of subsidies".	Nawaz (2010)
DEA and 2 nd stage Tobit regression	44 microfinance in Vietnam	Survey	Number of savers, number of borrowers and number of groups	Labor cost and Non-labor costs (Administrative expense)	Average technical efficiency: (SFA: 69%; DEA: 76%)	Nghiem, et al (2006)
Multivariate approach along with DEA	30 Latin American MFI's	Microrate web page. Data period: 2003	Number of loans outstanding; gross loan portfolio; interest and fee income	Credit officers and operating expenses	Level of efficiency achieved by a MFI depends on the specification chosen	Gutiérrez-Nieto, et al (2007)
DEA (both input-oriented and output oriented)	Bangladesh, India, and Pakistan	Micro Finance Network, Pakistan and Mix Market Network	Loans	Credit officers, cost per borrower	Analysis of single country data showed that eight, six, and five MFIs from Pakistan, Bangladesh, and India, respectively, were on the frontier	Qayyum and Ahmad (2006)
DEA, Tobit regression	200 Australian credit unions	Data, collected from Australian Financial Institutions Commission, corresponds to the financial year ending 30 June 1997	Personal loans and consumer credit facilities; property and real estate loans; commercial loans, deposits with other deposit-taking institutions; and financial securities	Labor, physical capital, loanable funds	Major sources of cost inefficiency is allocative inefficiency	Worthington (2000)

Table A.4 Definition of outputs and inputs

Variables		Definition
Outputs		
Gross loan portfolio (USD)	y ₁	All outstanding principal for all outstanding client loans, including current, delinquent, and restructured loans; but not loans that have been written off; it does not include interest receivable and employee loans.
Interest and fee income (USD)	y ₂	Interest income is the amount of money received from borrowers (excluding principal), while fee income is the amount of money earned as service charges, commissions, and penalties on loan portfolio
Inputs		
Total assets (USD)	x ₁	Total of all net asset accounts
Operating expenses (USD)	x ₂	Personnel expenses and administrative expenses
Financial expenses (USD)	x ₄	Total of financial expense on liabilities, net inflation adjustment, cost-of-funds adjustment, and other expenses from financial services
Number of staff (Number)	x ₃	Total number of personnel working
Efficiency Variables		
Percent of female borrower	z ₁	$\frac{\text{Number of active women borrowers}}{\text{Adjusted number of active borrowers}} * 100$
Operational self-sufficiency	z ₂	$\frac{\text{Financial Revenue}}{\text{Financial expense} + \text{Net loan loss provision expense} + \text{Operating expense}}$
Cost per borrower	z ₁	$\frac{\text{Adjusted operating expense}}{\text{Adjusted average number of active borrowers}}$
Loan loss rate	z ₄	$\frac{\text{Adjusted write – offs, net recoveries}}{\text{Adjusted average gross loan portfolio}}$
Debt to equity ratio	z ₅	$\frac{\text{Adjusted Total Liabilities}}{\text{Adjusted Total Equity}}$

Source: http://www.ruralfinance.org/fileadmin/templates/rflc/documents/1153991879090_Doc_8_2_Fin_Term_Definitions_Indicators.pdf

Table A.5 Descriptive statistics of variables used in this paper

	Mean	SD	Max	Min
Gross loan portfolio (USD)	159751161	238169539	939129906	2476575
Interest and fee income (USD)	41189598	63002289	273693774	758586
Total assets (USD)	230269370	378972750	1698487761	3570572
Operating expenses (USD)	18927373	26571552	97383681	402993
Financial expenses (USD)	12679578	27125192	143731019	107258
No. of staff (No.)	7424	9003	34841	273
% of female borrowers	0.95	0.07	1.03	0.65
Operational self-sufficiency	1.27	0.37	2.69	0.60
Cost per borrower	12.16	4.42	24.26	4.33
Loan loss rate	0.01	0.03	0.21	-0.01
Debt to equity ratio	4.84	3.70	15.92	0.36

Source: Estimated based on the data collected from MIX Market.