**IPRPD**
International Journal of Business & Management Studies
ISSN 2694-1430 (Print), 2694-1449 (Online)
Volume 02; Issue no 07: July, 2021

# The Effect of the Global Financial Crisis on the Cost Structure and Double Bottom Line Goal of Microfinance Institutions

**Amy Eremionkhale,[1] Todd A. Watkins [2]**

[1] *Clinical Assistant Professor of Economics, Andrew Young School of Policy Studies, Department of Economics, Georgia State University, USA*

[2] *Department of Economics, Lehigh University, USA*

## Abstract

*The objective of Microfinance institutions (MFIs) is often two-fold; the so-called double bottom line of seeking financial return sustainability, while also maximizing the social impact of their services on the lives of the poor individuals they serve. The pursuit of the social impact bottom line puts microfinance institutions in a peculiar position with regards to the response of their cost structure to the global financial crisis. This paper begins by investigating the impact of the global financial crisis on the cost structure, and cost inefficiencies of MFIs given their double bottom line pursuits. Overall, it appears that achieving growth in both dimensions of social impact and financial sustainability, grew more costly for the MFIs directly because of the global financial crisis. Moreover, given the risk-adjusted nature of the cost inefficiency measure used in the paper, the results show that maintaining a given level of risk in the loan portfolios became significantly more challenging for MFIs after the global financial crisis. In addition, the analysis performed here finds that more than two-thirds of the institutions in the industry are operating under economies of scale, although the proportion decreased after the global financial crisis. This suggests that some progress is evident towards broader achievement of the cost benefits of scale, but that the industry on average still has room for consolidations, mergers, and acquisitions. The analysis uses a time-invariant panel Stochastic Frontier Analysis with standard errors clustered at the country level. The data, from the Mix Market database, comprises 1400 Microfinance institutions across 108 countries.*

**Keywords:** *Microfinance institutions, global financial crisis, Mix Market, economies of scale, loan portfolio*

## 1.0 Introduction

Microfinance institutions (MFIs) provide financial services such as savings, loans and insurance to poor people who are most likely unable to obtain such services from the formal financial sector. The objective of an MFI is often two-fold; the so-called double bottom line of seeking financial return and sustainability, while also maximizing social impact on the lives of the poor. Many MFIs only lend, but as the industry has matured, many have obtained banking licenses and are able to accept deposits, broadening the services they are able to offer the poor. Bolli & Thi (2014); Roodman (2012); Baumol *et al.* (1982); Hartarska *et al.* (2013); Watkins (2018)

Understanding the cost implications of – and potential tensions between – delivering on the dual goals of financial service and social outreach are of central interest in the field of microfinance (Cull *et al.*, 2007; Hermes *et al.*, 2011; Annim, 2012). The double bottom line paradigm in the microfinance literature and among practitioners is strongly dependent on the theory of economies of scale (Robinson, 2001; Cull *et al.*, 2007; Watkins, 2020). To date, results exploring scale and efficiency in microfinance are uncomfortably divergent across the literature. Gonzalez (2007) finds that MFIs minimize their cost when they attract as few as only 2000 active borrowers. This number appears to be unrealistically low, given the empirical realities in practice; some MFIs each serve millions of clients. On the other hand, the value for the minimum efficient gross loan portfolio found in Bolli & Thi (2012, 2014) appears to us as also unreasonable on the other end, at $2.5 billion, again given the empirical information that exists on MFIs. Fewer than 0.6 percent of MFIs in our database operate at that scale.

In this paper, we improve on previous efforts to determine the minimum efficient scale MFIs need to be most cost efficient by enhancing a cost frontier function model and allowing for and measuring idiosyncratic individual MFI inefficiencies. We find minimum efficient scale on the order of several tens of millions of dollars of loan portfolio, an estimate better matching actual industry practice; but we also find that roughly 3 in 5 MFIs globally are operating at cost-inefficient small scales.

In addition, we extend the analysis by exploring, rather than ignoring, the impact of the 2009 global financial crisis on MFIs' cost structures. We add exploring the crisis because while performing preliminary analysis of the cost functional form for MFIs, we identified hints of a possible structural shift in the cost function after 2009, consistent with the financial market turmoil following the global financial crisis. For a motivating illustrative snapshot within a single MFI, Figure 1 shows the tremendous month-to-month growth in the risk faced by that MFI during 2009, measured by the fraction the MFI's loan portfolio at risk of default (PAR 30). We hypothesize that to manage portfolio risk during and following the global financial crisis, MFIs had to change their production processes significantly, which changed the cost structure and drove up costs of double bottom-line growth. To explore the possible structural shift in the sector globally, we compare cost frontier analyses across the entire time (2005-2015) to results using only the period before the global financial crisis (2005-2009) versus those after the global financial crisis (2010-2015). To the best of our knowledge there hasn't been another study conducted on the impact of the global financial crisis on the cost structure of MFIs, especially using the comprehensive global data and stochastic cost efficiency frontier methodology presented in the paper.

A related debate is whether the social mission conflicts with financial goals or if, instead, a microfinance institution cannot achieve the goal of social impact without pursuing economies of scale. The latter argument is that microfinance institutions become cost efficient through scale by leveraging the number of people served, reducing unit costs while simultaneously expanding social impact. There is a high administrative cost associated with the frequent transactions that occur with microcredit and microsavings, particularly for the poorest clients whose typical transactions can be very small. Thus, to control costs, a strong sentiment among supporters of commercial microfinance is that MFIs must achieve economies of scale (Roodman, 2012; Robinson, 2001; Watkins, 2020). However, the need to reduce cost has been found in certain literature (e.g., Bolli & Thi, 2014, 2012; Hermes *et al.*, 2011) to be against MFI activities that increase social outreach, rather than strictly focusing on financial production processes such as granting loans. Social impact is achieved, for example, by offering relatively small-sized loans to the poor, as opposed to larger-sized loans to more-privileged members of society. As an institution increases the number of poor individuals it serves, economies of scale can reduce the unit costs associated with each loan, thus enabling provision of loans and other services with lower rates and fees to the poor, enhancing social impact. (Robinson, 2001; Roodman, 2012; Watkins, 2020; Annim, 2012; Haq et al, 2010; Hartaska et al, 2009; Hartaska and Nadoluyak, 2007).

To investigate the direction of the synergy or conflict in the double-bottom line cost structure for MFIs, and how the global crisis affected that interrelationship, we estimate the minimum efficient scale (MES) for the gross loan portfolio of MFIs and how that scale efficiency interacts with the scope of social impact. We use as a proxy for social impact the inverse average loan size per borrower per GNI, a metric widely used in the literature. Overall, our analysis suggests that achieving growth in both dimensions of social outreach depth and financial scale grew more costly after the crisis. Since our cost inefficiency measure is risk adjusted, it appears that maintaining a given loan portfolio risk quality became significantly more challenging for MFIs after the global financial crisis.

## 2.0 Data

This paper uses an unbalanced panel dataset from the MixMarket database. The Microfinance Information Exchange (MixMarket) serves as an information clearinghouse for over 1800 microfinance institutions (Microfinance Information Exchange, 2016). The MixMarket provides the most comprehensive and current global information on MFIs (Annim, 2012; Hermes *et al.*, 2011). Although the MFIs in the sample are from diverse accounting and reporting backgrounds, the data provided by the Microfinance Information Exchange (2016) datasets feature validated information sourced directly from service providers and collected by local teams of analysts. Financial information is standardized according to internationally accepted accounting standards. This is advantageous for our purposes, allowing comparisons across MFIs, countries, and regions. (Annim, 2012; Cull *et al.*, 2007) Our analysis uses firm-level data from 1400 MFIs over the years 2005 - 2015, giving an unbalanced panel of 7,102 observations. The data spans 108 countries in 6 regions, namely: East Asia & The Pacific, Eastern Europe & Central Asia, Latin America & the Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa. We use data only from MFIs with more than one observation across time, and with complete information for all variables over the time. The independent variables used in the cost function are median adjusted prior to taking their logarithms, so our cost frontier point estimates are relative to the sample medians. (Bolli & Thi, 2014, 2012)

Descriptive statistics on all model variables appear in Table 1. Our trans-log cost function variables are derived in a manner similar to the work done by Bolli & Thi (2014, 2012). The financial variables are denominated in U.S. Dollars based on the exchange rates for each respective country, and thus control for country-specific inflation.

***Output Measures***- We use two output measures to capture the double bottom line impact on cost inefficiency for MFIs. (Hermes *et al.*, 2011) The first output variable is the gross loan portfolio, that is, the loan portfolio before subtracting loan loss reserves. This measures the financial production process, considering the differences in loan volume across institutions. Gross loan portfolio, *q1* in our models, is in millions of US dollars. (Bolli & Thi, 2014; Gropper & Hartarska, 2009)

The second output we use, *q2*, is the inverse of the average loan size per borrower per GNI. This variable is widely used in literature on microfinance as a proxy for depth of outreach to capture the social impact of the financial services. The strength of this measure for social outreach lies in its ability to control for the differences in wealth across countries and regions, while indicating if the MFIs are providing larger loans (to relatively richer clients) or small loans (to relatively poorer clients). (Bolli & Thi, 2014)

***Input Prices-*** The two input prices are *p1* and *p2*, where *p1* is calculated as operating expenses (in millions of USD) divided by the total personnel in each MFI over time, and *p2* is calculated as financial expenses divided by the sum of the total borrowings and total deposits. Our definition of *p2* improves on the definition used in Bolli & Thi (2014) because we include the total deposits. The rationale behind this approach is that MFIs can source their financial capital from either borrowings or deposits, and in some cases from both.

With regards to costs and the sourcing of funds by MFIs, providing savings is increasingly seen as potentially a more beneficial service for the poor with respect to the social impact of MFIs (Roodman, 2012; Cull *et al.*, 2007; Hermes *et al.*, 2011). Even though many MFIs now are taking deposits, most of the literature has so far not addressed savings services when performing cost analyses (Bolli & Thi, 2014, 2012). Our inclusion of savings in the cost frontier analysis serves as an important contribution to the research being done on the cost frontier analysis for microfinance institutions.

***Dependent Variable-*** The dependent variable is total expenditures for each MFI, *C*, measured in millions in US dollars. We use this for our cost frontier estimation, and to determine the cost inefficiencies for the various MFIs.

***Other Variables-*** Following the work of Bolli & Thi (2014, 2012) and Hartarska *et al.* (2013) we control for the level of credit risk associated with each MFI for each year, measured as the provision for loan impairments as a percentage of the gross loan portfolio, *risk*. This control variable is included in the cost function used to determine the firm specific cost inefficiency. This control variable accounts for the quality of the loans being issued by the MFIs, where lower asset quality (or higher non-performing loan ratio) has associated higher risk and therefore requires more resources to manage. (Hartarska *et al.*, 2013) In our model, we account for the panel data structure by including time as an exogenous variable. The time trend is captured by a set of dummy variables, one for each year. The time dummy variables allow our panel SFA model estimation to shift over time, capturing unmeasured time effects such as technological change and regulations. (Hartarska *et al.*, 2013)

## 3.0 Empirical Approach

To determine how far an MFI is from full-cost minimization (i.e., cost-efficiency), we use the cost frontier approach in our analysis. More specifically, we estimate a stochastic frontier cost function with an MFI-specific time-invariant inefficiency term. For the cost function, we choose a translog specification because it provides added flexibility in terms of approximating the unknown form of the cost function (Kumbhakar & Lovell, 2000; Coelli *et al.*, 2005; Tsionas & Kumbhakar, 2006; Kumbhakar *et al.*, 2014; Bolli & Thi, 2014; Christensen *et al.*, 1973). Since we are interested in measuring the possible existence of scale and scope economies, the translog form places no restrictions on the production cost elasticities and allows economies of scale and scope to vary with output.

$$\begin{aligned} \ln C_{it}^{*} = {} & \alpha_0 + \textstyle\sum_t \beta_t\, time_t \\ & + \textstyle\sum_{r=1}^{R} \beta_r \ln q_{rit} + \sum_{m=1}^{m-1} \gamma_m \ln p_{mit}^{*} \\ & + \tfrac{1}{2} \textstyle\sum_{r=1}^{R} \sum_{s=1}^{R} \beta_{rs} \ln q_{rit} \ln q_{sit} + \tfrac{1}{2} \sum_{m=1}^{M-1} \sum_{n=1}^{M-1} \gamma_{mn} \ln p_{mit}^{*} \ln p_{nit}^{*} \\ & + \textstyle\sum_{r=1}^{R} \sum_{m=1}^{M-1} \delta_{rm} \ln q_{rit} \ln p_{mit}^{*} + \phi \ln risk_{it} + u_i + v_i \end{aligned} \qquad (1)$$

where the dimensions $i = \{1..., I\}$, $t = \{2005...,2015\}$, $(m,n) = \{1,...,M\}$, and $(r,s) = \{1,...,R\}$, denote units of (MFI) observations, time, inputs, and outputs respectively. Input prices and outputs are represented as $p_{(m,n)it}$ and $p_{(r,s)it}$. $C_{it}^*$ and $p^*_{mit}$ represent, respectively, the total expenditure and input prices normalized by $p_{Mit}$, which in our case is $p_2$, the price for the MFIs to finance the capital for their loan operations. That is, $C_{it}^{*} = \frac{C_{it}}{p_{2it}}$ and $P_{1it}^{*} = \frac{p_{1it}}{p_{2it}}$. We do this normalization to impose price homogeneity. The measure of risk is the natural logarithm of *risk*, the provision for loan impairment rate. In other words, the cost estimates can be thought of as financial risk-adjusted costs of providing financial services and social outreach. The annual time dummy variables, $time_t$, capture unobserved heterogeneity across time. (Bolli & Thi, 2014, 2012)

The non-negative technical inefficiency effect $u_{it}$ is assumed to be independently and identically distributed as truncated normal with constant variance $\sigma_u$, but with means $\mu_i$ that are a linear function of the firm-specific variables and time. (Pitt & Lee, 1981; Kumbhakar, 1987a, b; Battese & Coelli, 1995; Meeusen & van den Broeck, 1977). The inefficiency specification used by Battese & Coelli (1995) is most frequently used in empirical studies.

Their model allows inefficiency to depend on some exogenous variables so that one can investigate how exogenous factors influence inefficiency.

$$\boldsymbol{u_{it} = u_i \sim iid\ N^+\ (\mu_i, \sigma_u^2)} \quad \textbf{(2)}$$

Our specification of the cost inefficiency term differs from the work of Bolli & Thi (2014, 2012), the paper after which we model our specification for the cost frontier, who assume a half normal distribution ($N^+(0, \sigma_u^2)$ )). We allow for increased flexibility in the model by assuming the modal firm's inefficiency is nonzero, i.e., the general case is a firm is inefficient, u>0, rather than assuming that the most common/modal firm is on the frontier at $u_i$=0. Our test results support the rejection of the null that $\mu = 0$, as seen in Table 3.

The idiosyncratic stochastic error term, $v_{it}$ is assumed normally distributed with a mean of zero and a standard deviation of $\sigma_v$, and the only panel-specific effect is the random inefficiency term. (Kumbhakar *et al.*, 2014)

$$\boldsymbol{v_{it} \sim iid\ N(0, \sigma_v^2)} \quad \textbf{(3)}$$

A potential problem of the estimated model is heteroskedasticity, as the data ranges over several MFIs across various countries in different regions. The problem of heteroskedasticity does not have a significant effect in the inefficiency error term, $u_{it}$. It is only significant in the unexplained error term and does not cause bias. (Kim *et al.*, 2008) We again depart from Bolli & Thi (2014) in the way we handle the issue of heteroskedasticity. Bolli & Thi (2014) include country specific fixed effects in their estimation of the cost frontier to account for unobserved heterogeneity across countries where the MFIs are located. However, Kumbhakar *et al.* (2014) find that including these fixed effects means severely negatively affects the estimated cost inefficiency term. With the aim of circumventing this problem, we estimate the idiosyncratic error by clustering at the country level, and do not include country fixed effects in our cost frontier estimation. The advantage of clustering as opposed to using the country fixed effect is that it produces standard errors that are robust to heteroskedasticity as well was intra-group correlation (Getz, 1979).

The cost inefficiency for each MFI is calculated following Kumbhakar & Lovell (2000).

$$\boldsymbol{E\{exp(u_i) \mid \varepsilon_{it}\} = \left\{\frac{1-\Phi\left(-\tilde{\sigma}_i - \frac{\tilde{\mu}_i}{\tilde{\sigma}_i}\right)}{1-\Phi\left(-\frac{\tilde{\mu}_i}{\tilde{\sigma}_i}\right)}\right\} \exp\left[\tilde{\mu}_i + \frac{1}{2}\,\tilde{\sigma}_i^2\right]} \quad \textbf{(4)}$$

where,

$$\boldsymbol{\tilde{\mu}_i = \frac{\mu\tilde{\sigma}_i^2 + \sum_{t=20--}^{T_i} \varepsilon_{it}\sigma_u^2}{\sigma_v^2 + \sum_{t=20--}^{T_i} \sigma_u^2}}$$

and,

$$\boldsymbol{\tilde{\sigma}_i^2 = \frac{\sigma_v^2\sigma_v^2}{\sigma_v^2 + \sum_{t=20--}^{T_i} \sigma_u^2}}$$

### *3.1 Economies of Scale*

In line with the work done by Baumol (1982); Baumol *et al.* (1982); Kim (1986); Iimi (2004); Bolli & Thi (2014, 2012), we estimate the cost elasticity of outputs *r* ($\eta_r$) using the median values of the other parameters - to determine economies of scale (SE) with respect to the gross loan portfolio (*q1*):

$$\boldsymbol{SE = \frac{1}{\sum_r \eta_r} = \frac{1}{\sum_r \left(\frac{\delta C}{\delta Y_r}\right)\Big/\left(\frac{C}{Y_r}\right)} = \frac{1}{\sum_r (\delta lnC/\delta lnY_r)}}$$

$$\boldsymbol{= \frac{1-(\beta_{lnq_1} + \beta_{lnq_2})}{\beta_{lnq_1} + \beta_{lnq_2} + (\beta_{lnq_1 lnq_2} + \beta_{lnq_1 lnq_1})\ x\ lnq_1}} \quad \textbf{(5)}$$

Given the calculation above, we can determine the proportion of MFIs operating at economies or dis-economies of scale. We do this for the six regions.

We also estimate minimum efficient scale (MES), the level of output where MFIs minimize their average unit cost. Given the median values of other variables, we calculate MES for the scale of gross lending portfolio, $q_1$, and the inverse average loan per borrower per GNI, $q_2$, using the following equations.

$$MES(q_1) = exp\left[\frac{1-(\beta_{lnq_1}+\beta_{lnq_2})}{(\beta_{lnq_1lnq_2}+\beta_{lnq_1lnq_1})}\right] x\, median(q_1) \quad (6)$$

$$MES(q_2) = exp\left[\frac{1-(\beta_{lnq_1}+\beta_{lnq_2})}{(\beta_{lnq_1lnq_2}+\beta_{lnq_2lnq_2})}\right] x\, median(q_2) \quad (7)$$

## 4.0 Results

In this section, we first discuss the cost frontier and the impact of the global financial crisis on it. We then proceed to compare economies of scale across the different regions, and our estimates of minimum efficient scale before and after the global financial crisis.

### *4.1 Cost Frontier and the Global Financial Crisis*

A main contribution we make to the current literature relates to the impact of the recent global financial crisis on the cost inefficiency for MFIs. We use 2009 as our break year because a substantial number of nations were in recession as of early 2009. We estimate the cost frontier for the years before and after 2009. Following this estimation, we test for any statistically significant difference in the cost structure before and after the financial crisis, i.e., in the changes in coefficients of the model. Our results are shown in Table 3.

The variable $\ln q1 \ln q2$ in the cost frontier model represents the joint production term. A positive sign on this variable indicates dis-economies of scope, where the double bottom-line combination of social outreach and a financial production process, as opposed to a strictly financial production process, hurts cost efficiency for the MFIs. The existence of a dis-economies of scope, which we find in our analysis, is consistently supported by the current literature. That is, serving the poorest of the poor is generally more costly. What is new here and previously unexplored, is that we find that the global financial crisis statistically significantly increased the cost inefficiency associated with joint production of social outreach and financial services. The positive coefficient on the joint production term, $\ln q1 \ln q2$, nearly doubled in size.

Overall, it appears that achieving growth in both dimensions of social outreach depth and financial scale, grew more costly. Moreover, we also find a positive and statistically significant increase in the coefficient on the variable that measures the portfolio risk faced by the MFIs. Maintaining a given loan portfolio risk quality appears to have become significantly more challenging and costly for MFIs after the global financial crisis.

Table 4 shows the average cost inefficiencies for the 6 regions and ranks them from the most efficient to the least efficient. Our findings suggest that the most cost-efficient region is Latin America & the Caribbean, with the lowest average cost inefficiency. From Table 4, we see that the MFIs located in Latin America & the Caribbean experience a cost of operating business that is 253% more on average than the cost faced by the MFIs operating on cost efficiency frontier. As for the region with the largest average cost inefficiency, South Asia, we see that it costs MFIs located in South Asia 355% more on average to operate than the most efficient firms on the frontier.

The kernel density estimates of these cost inefficiencies for the various regions are shown in Figure 2. From this figure, we can see the distribution of the cost inefficiencies across MFIs in each of the regions, as well as the rankings.

### *4.2 Economies of Scale*

Assuming the median prices and risk, an MFI would need to operate at a minimum $26.4 million in gross loan portfolio to minimize its unit cost (i.e., achieve minimum efficient scale). This operating scale is substantially higher than MFIs in the range of the 2000-client MES estimate of Gonzalez (2007) and is very substantially lower than the $2.5 billion MES gross loan portfolio reported in Bolli & Thi (2014). We estimate the proportion of firms operating at an increasing economy of scale for the given regions in Table 5. As the table shows, most of the MFIs across the various region are operating too small, not yet fully taking advantage of available scale economies that could reduce costs. We also see from Table 5 that the proportion of MFIs operating with increasing economies of scale decreases in all six regions after the global financial crisis yet remains above 3 in 5 MFIs in all regions. This finding is in line with the critical assessment of the industry by Robinson (2001). This finding suggests there remains substantial room for consolidations and mergers & acquisitions in the global microfinance industry.

In terms of our measure of the depth of social outreach to the poorest, *q2*, the inverse average loan per borrower per GNI, we find that the optimum is approximately 11.29. That is, firms on the efficient frontier have social outreach when providing loans on average as small as 1/11th of the gross national income per capita. Which would be, for example, loans of roughly $50 in Afghanistan; $100 in Bangladesh; or $150 in Ukraine. Serving very poor clients with loans this small can be cost efficient for firms on the frontier, but the majority of firms are not there. Average loans are substantially larger, which suggests there is potential for greater depth of social impact if efficiencies improve.

Expanding the empirical methodology of Bolli & Thi (2014), we include deposits taken by the MFIs in calculating the financial price, *p2*, in the model. This improvement corrects a problematic puzzle identified by Bolli & Thi (2014), in their empirical results. In one region, Eastern Europe, and Central Asia, they find a negative coefficient on the quadratic scale term. This is suggestive of strong dis-economies of scale even for very small MFIs,

which appears inconsistent with the empirical trends elsewhere in the world. Our region-specific estimates, not shown here but available on request, have the positive coefficients on all regions.

## 5.0 Conclusion

The existence of a cost disadvantage associated with achieving the double bottom line, which we find in our analysis, is consistent with current literature. That is, serving the poorest of the poor is generally more costly. What is new here and previously unexplored, is that we find the global financial crisis has statistically significantly increased the cost inefficiency associated with jointly producing both social outreach to the poorest and financial services. The positive coefficient on the joint production term, $\ln q1 \ln q2$, nearly doubled in size. Therefore, we find that the cost of double line pursuits was driven even higher after the financial crisis for MFIs who serve a poorer clientele. As it relates to portfolio risk, we find that maintaining a given loan portfolio risk quality appears to have become significantly more challenging and costly for MFIs after the global financial crisis.

In addition, the analysis performed here finds that more than two-thirds of the institutions in the industry are operating under economies of scale, although the proportion decreased after the global financial crisis. This suggests that some progress is evident towards broader achievement of the cost benefits of scale, but that the industry on average still has room for consolidations, mergers, and acquisitions. We find that the on the efficient frontier, gross national income (GNI) per capita has a size of approximately twelve times an average loan. Also, that assuming the median prices and risk MFIs operating on the efficient frontier achieve minimum efficient scale at $26.4 million in gross loan portfolio.

## Works Citation


Annim, Samuel Kobina. 2012. Microfinance Efficiency: Trade-Offs and Complementarities between the Objectives of Microfinance Institutions and Their Performance Perspectives. *European Journal of Development Research*, **24**(5), 788–07.

Battese, G. E., & Coelli, T. J. 1995. A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics*, **20**, 325–332.

Baumol, William J. 1982. Contestable markets: an uprising in the theory of industry structure. *American Economic Review*, **72**(1), 1–15.

Baumol, William J., Panzar, John C., & Willig, Robert D. 1982. Contestable Markets and the Theory of Industry Structure. *New York: Harcourt Brace Jovanovich, Inc.*

Bolli, Thomas, & Thi, Anh Vo. 2012. On the Estimation Stability of Efficiency and Economies of Scale in Microfinance Institutions. *KOF Working Papers*, January.

Bolli, Thomas, & Thi, Anh Vo. 2014. Regional differences in the prodcution processes of financial and socila outputs of microfinance institutions. *Economics of Transition*, **22**(3), 461–495.

Christensen, Laurits R., Jorgenson, Dale W., & Lau, Lawrence J. 1973. Transcendental Logarithmic Production Frontiers. *The Review of Economics and Statistics*, **55**(1), 28– 45.

Coelli, T.J., Rao, D.S. Prasada, O'Donnell, Christopher J., & Battese, G.E. 2005. *An Introduction to Efficiency and Productivity Analysis*. Springer Science + Business Media, Inc.

Cull, Robert, Demirgu¨¸c-Kunt, Asli, & Morduch, Jonathan. 2007. Financial performance and outreach: a global analysis of leading microbanks*. *The Economic Journal*, **117**(517), F107–F133.

Getz, Malcolm. 1979 (March). *Comparing Public Library Systems*. Working Paper 323. National Bureau of Economic Research.

Gonzalez, Adrian. 2007 (September). *Efficiency Drivers of Microfinance Institutions (MFIs): The Case of Operating Costs*.

Gropper, Daniel M, & Hartarska, Valentina. 2009. Which Microfinance Institutions Are Becoming More Cost Effective with Time? Evidence From a Mixture Model. *Journal of money creit and banking*, **41**(4), 651–672.

Hartarska, Valentina, Shen, Xuan, & Mersland, Roy. 2013. Scale economies and input price elasticities in microfinance institutions. *Journal of Banking & Finance*, **37**(1), 118–131.

Hermes, Niels, Lensink, Robert, & Meesters, Aljar. 2011. Outreach and Efficiency of Microfinance Institutions. *World Development*, **39**(6), 938–948.

Iimi, Atsushi. 2004. Banking Sector Reforms in Pakistan: Economies of Scale and Scope, and Cost Complementarities. *Journal of Asian Economics*, **15**(3), 507–528.

Kim, H. Youn. 1986. Economies of Scale and Economies of Scope in Multiproduct Financial Institutions: Further Evidence from Credit Unions. *Journal of Money, Credit and Banking*, **18**(2), 220–226.

Kim, Taeyoon, Brorsen, Wade, & Kenkel, Philip. 2008. Estimation of Efficiency with the Stochastic Frontier Cost Function and Heteroscedasticity: A Monte Carlo Study. *In: American Agricultural Economics Association Annual Meeting*. Orlando, Fl: http://ageconsearch.umn.edu/bitstream/6408/2/469690.pdf.

Kumbhakar, S.C., & Lovell, C.A.K. 2000. *Stochastic Frontier Analysis*. Cambridge University Press, U.K.

Kumbhakar, Subal C. 1987a. Production Frontiers and Panel Data: An Application to U.S. Class 1 Railroads. *Journal of Business Economic Statistics*, **5**(2), 249–255.

Kumbhakar, Subal C. 1987b. The specification of technical and allocative inefficiency in stochastic production and profit frontiers. *Journal of Econometrics*, **34**(3), 335–348.

Kumbhakar, Subal C., Lien, Gudbrand, & Hardaker, J. Brian. 2014. Technical efficiency in competing panel data models: a study of Norwegian grain farming. *Journal of Productivity Analysis*, **41**(2), 321–337.

Meeusen, Wim, & van den Broeck, Julien. 1977. Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. *International Economic Review*, **18**(2), 435–444.

Microfinance Information Exchange, MIX. 2016 (November). *ABOUT MIX MARKET*.

Pitt, Mark, & Lee, Lung-Fei. 1981. The measurement and sources of technical inefficiency in the Indonesian weaving industry. *Journal of Development Economics*, **9**(1), 43–64.

Robinson, Marguerite. 2001. *The Microfinance Revolution: Sustainable Finance for the Poor*. World Bank Publications.

Roodman, David. 2012. *Due Dilligence: An Impertinent Inquiry into Microfinance*. Center for Global Development.

Tsionas, Efthymios, & Kumbhakar, Subal. 2006. *Estimation of Technical and Allocative Inefficiencies in a Cost System: An Exact Maximum Likelihood Approach*. MPRA Paper. University Library of Munich, Germany.

Watkins, Todd A. 2018. *Introduction to microfinance*. World Scientific.

Watkins, Todd A. 2020. Microfinance Industry Concentration and the Role of Large-Scale and Profitable MFIs. *In:* Lieberman, Ira W., DiLeo, Paul, Watkins, Todd A., & Kanze, Anna (eds), *The Future of Microfinance*. Brookings Institution Press.

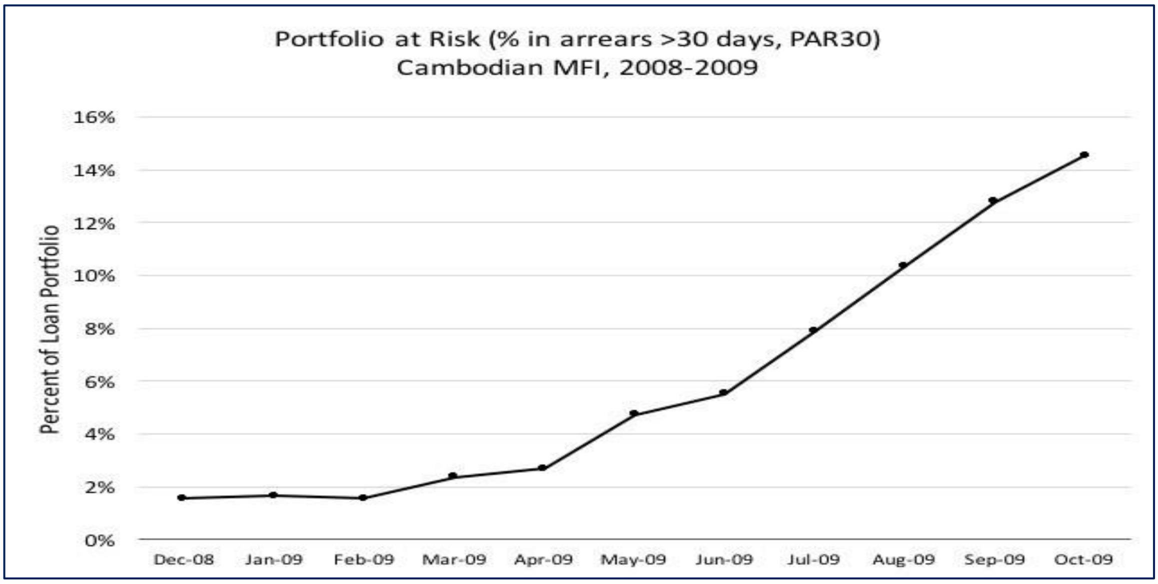


**Figure 1**

| Cost Frontier Variable | Mean | Median | Std. Dev. | Min. | Max. | N | 2005-2009 | N | 2010-2015 | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Dependent Variables Cit** [Total expenditures in million US$] | 14.75 | 2.32 | 55.59 | 0 | 1,811.14 | 7102 | 9.548 | 3545 | 19.932 | 3557 |
| **Output Measures** | | | | | | | | | | |
| $q1_{it}$ [*Gross Loan Portfolio in million US$*] | 61 | 7.32 | 288 | 0 | 13,132 | 7102 | 37.7 | 3545 | 85.038 | 3557 |
| $q2_{it}$ [*Inv average loan balance per borrower per GNI*] | 6.625 | 3.4 | 17.269 | 0.018 | 1250 | 7102 | 6.556 | 3545 | 6.695 | 3557 |
| **Input Prices** | | | | | | | | | | |
| $p1_{it}$ [*Operating expenses per personnel in million US$*] | 0.02 | 0.015 | 0.276 | 0 | 23.261 | 7102 | 0.016 | 3545 | 0.025 | 3557 |
| $p2_{it}$ [*Financial expenses per borrowings in million US$*] | 8.375 | 816 | 300.804 | 0 | 22107.6 | 7102 | 7.151 | 3545 | 9.597 | 3557 |
| **Control Variable risk** [*Provision for loan impairments in %*] | 6.624 | 1.67 | 284 | 0 | 23,831 | 7102 | 3.258 | 3545 | 9.98 | 3557 |

**Table 1: Summary Statistics**

Note: The summary statistics have been taken of the variables prior to any normalization and logarithmizing. The table also shows the summary statistics for the variable before and after the global financial crisis.

| Fiscal | Region | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Sub-Saharan Africa | East Asia & the Pacific | Eastern Europe & Central Asia | Latin America & The Caribbean | Middle East & North Africa | South Asia | Total |
| 2005 | 60 | 60 | 73 | 143 | 18 | 72 | 426 |
| 2006 | 102 | 90 | 119 | 211 | 25 | 88 | 635 |
| 2007 | 121 | 108 | 141 | 244 | 30 | 111 | 755 |
| 2008 | 119 | 96 | 169 | 292 | 35 | 123 | 834 |
| 2009 | 107 | 94 | 170 | 317 | 35 | 172 | 895 |
| 2010 | 104 | 108 | 146 | 319 | 35 | 177 | 889 |
| 2011 | 99 | 102 | 98 | 304 | 32 | 177 | 812 |
| 2012 | 68 | 48 | 88 | 240 | 10 | 146 | 600 |
| 2013 | 65 | 61 | 61 | 225 | 11 | 79 | 502 |
| 2014 | 77 | 77 | 60 | 214 | 17 | 89 | 534 |
| 2015 | 55 | 41 | 21 | 83 | 11 | 9 | 220 |
| **Total** | **977** | **885** | **1,146** | **2,592** | **259** | **1,243** | **7,102** |

**Table 2: Distribution of observations across time and region**

| | (1) All Years | (2) 2005-2009 | (3) 2010-2015 | (4) Difference |
|---|---|---|---|---|
| lq1 | 0.713*** | 0.731*** | 0.747*** | 0.016 |
| | (0.00639) | (0.00952) | (0.00879) | (0.01027) |
| lq2 | 0.239*** | 0.228*** | 0.215*** | -0.013 |
| | (0.00941) | (0.0141) | (0.0128) | (0.0082) |
| lq1lq1 | 0.0235*** | 0.0257*** | 0.0293*** | 0.0036 |
| | (0.00137) | (0.00232) | (0.00218) | (0.0032) |
| lq2lq2 | 0.0263*** | 0.0279*** | 0.0314*** | 0.0035 |
| | (0.00410) | (0.00604) | (0.00596) | (0.0025) |
| lq1lq2 | 0.0139*** | 0.0153** | 0.0296*** | 0.0143*** |
| | (0.00321) | (0.00560) | (0.00522) | (0.007) |
| lp1star | 0.802*** | 0.791*** | 0.784*** | -0.007 |
| | (0.00527) | (0.00774) | (0.00790) | (0.0199) |
| lrisk | 0.0566*** | 0.0503*** | 0.0642*** | 0.0139*** |
| | (0.00267) | (0.00387) | (0.00374) | (0.0029) |
| lp1lp1 | -0.00842*** | -0.00869*** | -0.00988*** | -0.00119 |
| | (0.000255) | (0.000361) | (0.000400) | (0.0021) |
| lp1lq1 | -0.0107*** | -0.0116*** | -0.0196** | -0.008 |
| | (0.00115) | (0.00175) | (0.00213) | (0.0096) |
| lp1lq2 | -0.000772 | 0.000444 | -0.00737*** | -0.00781 |
| | (0.00127) | (0.00183) | (0.00213) | (0.00427) |
| _cons | -2.845** | -2.910** | -3.067 | -0.157*** |
| | (0.932) | (1.109) | (2.190) | (0.0541) |
| mu | 2.886** | 2.984** | 3.106 | 0.122*** |
| | (0.932) | (1.109) | (2.189) | (0.249) |
| *N* | 7102 | 3545 | 3557 | 7102 |

**Table 3: The cost Frontier**

*** Standard errors in parentheses**

| Cost Inefficiency | Mean | Std. Dev. | N |
|---|---|---|---|
| 2005-2009 | 293.3 | 66.5 | 3545 |
| 2010-2015 | 289.7 | 64.9 | 3557 |
| Latin America & The Carabbean | 252.7 | 48.1 | 2592 |
| Eastern Europe & Central Asia | 264.6 | 65.4 | 1146 |
| Middle East & North Africa | 288.9 | 51.6 | 259 |
| East Asia & The Pacific | 305.7 | 52.6 | 885 |
| Sub-Saharan Africa | 333.5 | 49.3 | 977 |
| South Asia | 354.6 | 46.6 | 1243 |
| Global | 291.5 | 65.7 | 7102 |

**Table 4: On Average, % by which Unit Costs are above Efficient Frontier, sorted by region**

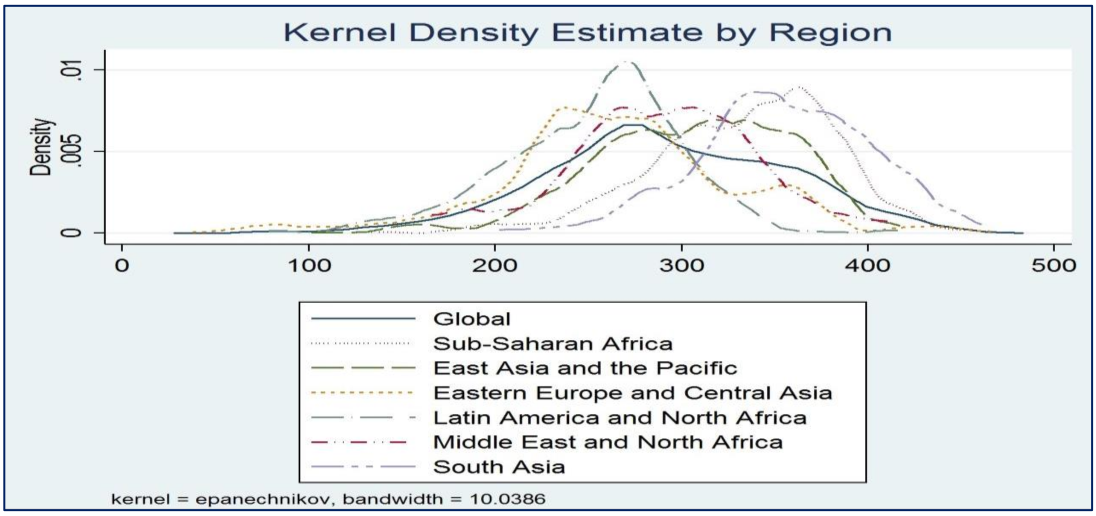


**Figure 2: Distribution of Cost Inefficiency by Region**

| Region | All Years | 2005-2009 | 2010-2015 |
|---|---|---|---|
| Sub - Saharan Africa | 80.96 | 84.48 | 77.14 |
| East Asia and the Pacific | 83.73 | 92.86 | 74.37 |
| Eastern Europe and Central Asia | 68.85 | 73.21 | 62.66 |
| Latin America and The Caribbean | 66.90 | 73.57 | 61.08 |
| Middle East and North Africa | 73.36 | 83.22 | 61.21 |
| South Asia | 75.22 | 80.57 | 70.75 |

**Table 5: Proportion of MFIs with increasing economies of scale**

| | q1 | q2 | p1 | p2 | C | Risk |
|---|---|---|---|---|---|---|
| q1 | 1 | | | | | |
| q2 | -0.0380* | 1 | | | | |
| p1 | 0.0369* | -0.0062 | 1 | | | |
| p2 | -0.0002 | 0.0038 | 0.0024 | 1 | | |
| C | 0.8498* | -0.0164 | 0.3516* | -6E-04 | 1 | |
| Risk | -0.0027 | 0.0974* | -0.0006 | -5E-04 | -0.002 | 1 |

**Table 6: Cross-correlations of outputs, inputs, prices, and costs**