**Scale economies and input price elasticities in microfinance institutions**

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**Abstract**

We evaluate the efficiency of microfinance institutions (MFIs) using a structural approach which also captures these institutions' outreach and sustainability objectives. We estimate economies of scale and input price elasticities for lending-only and deposit-mobilizing MFIs using a large sample of high-quality panel data. The results confirm conjectures that improvements in efficiency can come from the growth or consolidations of MFIs, as we find substantial increasing returns to scale for all but profitability-focused deposit-mobilizing MFIs. Our results support the existence of a trade-off between outreach and sustainability. All inputs are inelastic substitutes, but we find differences in own-price elasticities in lending-only and deposit –mobilizing MFIs.

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## 1. Introduction

Microfinance is the supply of financial services to micro-enterprises and poor families. Considerable public recognition of microfinance as a development tool has resulted from the United Nations' Year of Microcredit in 2005 and the awarding of the Nobel Peace Prize to Mohammad Yunus and the Grameen Bank in 2006. More recently, microfinance has attracted private investors because it offers a new class of assets and can improve portfolio diversification. Outreach by microfinance institutions (MFIs) has grown tremendously during the past decade, and microfinance now reaches more than 150 million borrowers.[1]

Despite such achievements, microfinance reaches only a fraction of the world's poor, with perhaps $200 billion more needed to meet worldwide demand (Swanson, 2008). Most MFIs are small, reach only a few thousand clients, remain costly to operate and risk drifting toward better-off clients (Daley-Harris, 2009; Mersland and Strøm, 2010). Therefore, an efficiency analysis focused on estimating the economies of scale in the industry and how MFIs mix inputs to offer financial services to the world's poor is timely and important.

Numerous studies on scale economies of commercial banks use the structural approach to efficiency, in which cost or profit functions are estimated (Hughes and Mester, 2008a). Surprisingly, in microfinance, most studies use a non-structural approach and analyze efficiency and productivity using ratios developed by the MicroBanking Bulletin (MBB) in the 1990s (e.g., Cull et al., 2007).[2]

Scale efficiency has not been the focus of the few applications of a structural approach, which have studied MFIs' governance, evolution in time, or mission drift (Caudill et al., 2009; Hartarska and Mersland, 2012; Hermes et al., 2011). Such studies include stochastic frontier (SFA) analysis, which measures an individual MFI's efficiency as the distance to an optimal

[1] Source: MicrocreditSummit.org

[2] (see Berger and Mester, 1997, 2003; Berger, 2007 for surveys of the literature)

frontier defined by the best performers in the sample, or data envelopment analysis (DEA), which does not make behavioral assumptions (e.g., cost minimization) about the objectives of MFIs (Gutierrez-Nieto et al., 2007; Balkenhol, 2008; Nawaz, 2009). Another line of recent efficiency work estimates scope economies from the joint provision of microsavings and microloans (Hartarska et al., 2010, 2011) by MFIs worldwide.

However, there are no published studies focused on scale efficiency in MFIs and on analyzing the elasticities of substitution among inputs to illuminate how MFIs combine inputs to provide financial services to clientele not served by typical banks. We present the first such estimates and discuss elasticities of substitution among inputs. We use the classical seemingly unrelated regressions (SUR) on a system of equations consisting of cost function and cost share equations and high-quality panel data from MFIs operating in 69 countries.[3] We apply a modified production approach employed in efficiency analyses of banks and financial institutions to better capture the objectives of MFIs, following recent cost function specifications in microfinance (Caudill et al., 2009, Hartarska and Mersland, 2012; Hartarska et al., 2011).

Our approach captures MFIs' sustainability goal through the assumption of cost minimization as well as their outreach goal of serving as many poor clients as possible. The latter is achieved by measuring outputs within the cost function by the number of active clients served (borrowers only or borrowers and savers).[4] We compare these results with results where outputs are loan portfolios (and deposits) measured in dollars to determine how serving poorer borrowers with smaller loans and collecting smaller savings may affect efficiency estimates. We also split the sample by MFI type – lending-only and savings-collecting (which also lend) – to determine

[3] Recent work has demonstrated that the joint estimation of the equivalent production function and first-order conditions with normalization (which is our approach) is superior to single equation modeling, which is prevalent in banking studies (León-Ledesma et al., 2010).
[4] A similar approach appropriate for other financial industries is used by Van Cayseele and Wuyts (2007).

whether efficiency estimates differ by business model. Efficiency differences along this dimension provide insights into the industry's push toward realizing scope economies by transforming MFIs into deposit-collecting institutions.

Our empirical evidence confirms previous conjectures that microfinance growth potential can be achieved by realizing economies of scale. The results show that MFIs can generate sizable cost savings though growth or consolidation. We find that all inputs are inelastic substitutes, indicating that very large changes in the price of one input are needed to induce substitution away from this input. We find differences in own-price elasticities by business model with inelastic labor and elastic physical and financial capitals in lending-only MFIs. In savings-collecting MFIs, physical capital is unit elastic, whereas labor and financial capital are elastic.

The rest of this paper is organized as follows: Section 2 briefly describes the MFI industry-specific characteristics. Section 3 presents the empirical approach. Section 4 discusses the data, Section 5 discusses the empirical results, and Section 6 concludes.

## 2. Brief overview of microfinance institutions

Microfinance Institutions (MFIs) provide banking services to the poor. The objective of an MFI is to improve outreach (i.e. serving as many poor customers as possible) while remaining financially sustainable (i.e. covering its costs). Most MFIs only lend, but more recently, many have obtained banking licenses and are able to mobilize deposits. The most recent data show that approximately one-quarter of MFIs collect savings (i.e. are deposit-mobilizing MFIs), with three quarters remaining lending-only (mixmarket.org).

MFIs can be organized as banks, non-bank financial institutions (NBFIs), non-governmental organizations (NGOs), or cooperatives (credit unions or co-ops), depending on a country's laws and an MFI's background. These MFIs compose an industry because all offer small loans (and savings products in the case of deposit-collecting institutions) to marginal clients who are normally not served by banks or other financial institutions.

Because lending to poor people is costly, MFIs use a variety of innovative lending methodologies – individual lending without collateral or with non-traditional collateral (with low market value but high personal value, e.g., TV sets, bikes, etc.), group lending methodologies such as solidarity groups and village banking, where the group of borrowers assume responsibility for screening, monitoring and contract enforcement and thus substantially lower the costs of service delivery. Typical in microlending is the requirement of frequent repayment as a means of encouraging and enforcing repayment discipline. Diligent borrowers gain access to larger amounts of loans in the future, which serves as an additional repayment enforcement mechanism.

Historically, MFIs were created with donor funds or with funds by institutional investors (e.g., the World Bank) or private charities (e.g., Opportunity International), which continue to remain engaged in the MFIs by providing loans, sometimes at below-market rates, and grants under special circumstances. Increasingly, however, private investors attracted to MFIs' returns on investment have become involved as investors or as creditors, and generally the international influence in the microfinance industry is high (Mersland et al., 2011). Several microfinance studies have reported that MFI performance is not affected by the type of organization (lending-only vs. deposit-collecting) and financial banking regulations; therefore, efficiency studies analyze all MFIs as an industry (Hartarska and Nadolnyak, 2007; Mersland and Strøm, 2009).

**3. Estimation approach**

A structural approach to efficiency in financial institutions involves estimating a profit or cost function to determine the optimal scale and input price elasticities. For the microfinance industry, cost functions are estimated for several reasons. First, the cost function assumes exogenous output and uses input prices, whereas the profit function uses input and output prices, which is problematic for a study on MFIs because detailed price data (interest rates charged) on loans are not collected. Furthermore, from a theoretical perspective, the cost function is more appropriate when firms are price takers in the input markets (labor and capital) and have some market power in the output market (Varian, 1984). MFIs have some market power in serving the poor, as other lenders avoid them. In the input market, MFIs are price takers because they pay competitive salaries for relatively skilled labor, compete with peers worldwide for access to financial capital (loans and donations), and participate in a competitive market for physical capital. Finally, some MFIs operate as for-profit entities, but the majority remain not-for-profit; although not all MFIs maximize profits, all strive to minimize cost.

Therefore, we estimate a typical translog cost function

$$lnC = \alpha_0 + \sum \alpha_j lnq_j + \sum \beta_k lnp_k + \frac{1}{2}\sum \alpha_{ij} lnq_i\, lnq_j + \frac{1}{2}\sum \beta_{lk} lnp_l\, lnp_k + \sum \delta_{jk} lnq_j\, lnp_k + z_m + \frac{1}{2}\sum \gamma_{mn} z_m\, z_n + \sum \gamma_{km} lnp_k z_m + \sum \gamma_{qm} lnq_i z_m + lnv \quad (1)$$

where $C$ is total cost; $q_j$ are output(s); $p_k$ are input prices; $z_m$ are control variables; $\alpha$, $\beta$, $\delta$, and $\gamma$ are parameters to be estimated; and $lnv$ is the standard error term. Homogeneity in input prices requires $\Sigma\beta_k = 1$, $\Sigma\beta_{lk} = \Sigma\beta_{kl} = 0$ over $l$ and $k$, $\Sigma\delta_{jk} = 0$ for any $q_j$ and $\Sigma\gamma_{km}=0$ for any $z_m$. These restrictions are imposed in the estimation by normalizing (dividing) all input prices and total cost by the price of physical capital. The data are mean-scaled (divided by their means) to facilitate calculation of scale economies.

Estimating financial institutions' cost functions must also consider credit risk, which is typically measured by non-performing loan ratios. This consideration is needed because lower asset quality (or higher nonperforming loan ratio) requires more resources to manage the higher risk, and if asset quality is not accounted for, the estimated scale economies will be reduced. Therefore, the results may show that there are economies of scale, whereas, in fact, when risk is incorporated, financial institutions operate at minimum costs with constant returns to scale (Hughes and Mester, 1998b).[5] Therefore, we also control for the level of risk using a variable measuring the ratio of loans delinquent by more than 30 days to the total portfolio, which is a standard ratio used by MFIs to measure the risk level of their loan portfolio.

Because technology changes over time, banking scale economies studies add a time trend as a proxy for technical progress. Technical progress is expected to reduce total cost, so the expectation is that costs will decrease with time, which is captured by the derivative of cost with respect to time.[6] A technical progress term is both added directly and interacted with risk, input price and output variables. [7]

To improve the efficiency of the estimation, we estimate the cost function jointly with cost share equations derived from Shepherd's Lemma. These cost share equations are derived as $s_k = \partial lnC/\partial lnp_k$, or

$$s_k = \beta_k + \sum \beta_{lk} lnp_l + \sum \delta_{jk} lnq_j + \sum \gamma_{km} z_{\mathrm{m}} + ln\nu_k \qquad (2)$$

with cross-equation parameter constraints imposed. The translog cost function, along with the share equations, is estimated using the seemingly unrelated regressions (SUR) method. Recent work examining the production function (equivalent to our cost function) has demonstrated that the joint estimation of this function with first-order conditions is preferable to single equation

[5] An additional factor discussed by these authors is the liquidity risk part related to banks deposit taking function, but because most MFIs do not collect deposits, we do not add such a control variable.
[6] Altunbas et al. (2000) also argue that when the overall economic conditions are not included in the model, the time trend will capture the time dimension and other dynamics.
[7] The results from banking studies suggest that the technical progress term is much stronger for smaller banks, and we expect that because MFIs are relatively small, this term will be significant (Lang and Welzel, 1996).

estimation, especially when combined with *normalization*, which we do using the price of (physical) capital (León-Ledesma et al., 2010).

Two main approaches exist for specifying the main elements of the cost function (input prices, outputs and costs), namely the intermediation and production approaches. Whereas the intermediation approach assumes that financial firms intermediate (i.e., use deposits to produce loans, measured in dollars), the production approach considers deposits to be outputs and measures the outputs using the number of client accounts. The implication is that interest expense on deposits in the intermediation approach is part of the cost of capital, whereas the production approach uses only operating expenses as input prices. Microfinance studies estimate a cost function with a modified approach similar to that employed in some banking studies (e.g., Berger and Humphrey, 1991; Mitchell and Onvural, 1996).

In this paper, we follow Caudill et al. (2009) and Hermes et al. (2011) and use their modified approach. In particular, interest paid on deposits is accounted for within the cost of financial capital (the intermediation approach). Output is measured in two ways. First, to better reflect the objective of the MFIs to serve marginal clientele rather than intermediate funds, output is measured as the number of borrowers (and savers), as in Hartarska et al. (2011) and Caudill el al. (2009). Second, for comparison purposes, it is measured as the value of loans (and deposits), as in the common intermediation approach.

The components of input prices are the three classical inputs in microfinance and banking studies – the average salary per worker to measure the price of labor, the ratio between non-labor operating expenses and net fixed capital to measure the price of physical capital, and the cost of capital – as specified in the modified approach (Caudill et al., 2009; Mitchell and Onvural, 1996).

Within the microfinance industry, lending remains the dominant objective, with the majority of MFIs only lending and only some mobilizing savings. Therefore, between the two types of output specifications, we estimate specifications with one output (lending only) and with two outputs (loans and savings). Next, we split the sample into lending-only MFIs and deposit mobilizing MFIs and estimate one- and two-output specifications, each measured in dollar terms and by the number of active clients (borrowers and savers).

In addition to standard cost function variables (input prices and output quantities); controls for risk, which are essential in financial institutions; the country of operation for cross-sectional data; and time trends, because we have panel data, we also control for MFI-specific characteristics and country-specific characteristics. These variables capture the possible impact of the legal environment and microfinance competition through two specially constructed indexes (based on information provided by the rating agencies), the dominant lending method (individual lending, village banks and solidarity groups), and a dummy variable for being subject to regulation by a banking authority. Therefore, our specifications allow cross-country MFI data to estimate cost efficiency and elasticities, similar to recent banking cross-country studies (Fries and Taci, 2005; Bos and Kool, 2006).

Economies of scale exist if an increase in output, holding all input prices constant, causes a less-than-proportional increase in total cost. Therefore, economies of scale are calculated by taking the derivative of $lnC$ with respect to output(s). Because variables are mean scaled, the partial scale is given by the estimates for $\alpha_j$ in the one-output model and by the sum of $\alpha_i$ and $\alpha_j$ for the two-output model. Economies of scale (increasing returns to scale) exist if the partial in (1) is less than one, diseconomies of scale (decreasing returns to scale) exist if it is smaller than one, and constant returns to scale exist when this coefficient is equal to one.

We expect to find increasing returns to scale if MFIs would benefit from either expanding output (number of clients or volume of services) or consolidating to take advantage of cost-saving opportunities. Because the sample we use contains smaller MFIs compared with those in other datasets (e.g., the Mix Market Information Exchange), economies of scale are likely to exist and would indicate that MFIs would benefit from moving rightward along their cost curve.

In addition to estimating scale economies, we also calculate the Allen own- and cross-price elasticities of substitution for the production inputs used in the model (labor, physical capital, and financial capital) to show how MFIs use inputs to achieve their objectives. Parameter estimates from the translog cost function allow calculations of elasticities of substitution:

Parameter estimates from the translog cost function allow calculations of Allen-Uzawa elasticities of substitution:

$$\theta_{lk} = 1 + \beta_{lk}/s_1 s_k \text{ for } l \neq k; \qquad \theta_{ll} = (\beta_{ll} + s_l^{\,2} - s_l) / s_l^{\,2} \tag{3}$$

and own-price elasticities of demand are as follows:

$$\eta_{ll} = s_l \quad \theta_{ll} \tag{4}$$

where $\beta_{lk}$ is the respective cross-price coefficient (from eq. (1)), $\beta_{ll}$ is the respective own-price coefficient (from eq. (1)), $s_l$ and $s_k$ are the respective input shares, [$(P_l * Q_l)/TC$]. The own-price elasticity should be negative in accordance with the law of demand. Inelastic demand may indicate more vulnerability to monopsonistic power.

To save space, we only present estimates of the cost function, as estimates of the cost share equations are not informative by themselves. However, these estimates are used to calculate elasticities, which we present in a separate table (Table 7).

## 4. Data

This dataset was assembled from rating reports that were completed by five microfinance rating agencies and available for different time periods and on different websites.[8] The dataset contains MFIs from 69 countries with at least three annual observations per MFI for the period 1998 to 2010. In total, the dataset consists of 989 annual MFI observations. To minimize the impact of outliers, we exclude the top and bottom 1%. A list of countries and the number of observations per country in the sample are available in the appendix.

We define the input price of labor as the average annual salary per employee, the cost of capital is the cost of purchased funds (including the cost of deposits), and the input price of physical capital is the ratio of non-labor operating expenses to the value of net fixed assets, which is consistent with previous studies applying the modified production/intermediation approach (e.g., Berger and Humphrey, 1991; Mitchell and Onvural, 1996).). Total costs (TC) are the sum of input prices and input quantities.

Table 1 presents the summary statistics of the variables used in the analysis, and more detailed characteristics of the dataset are presented in the appendix. [9] The first column on Table 1 contains the average values for the sample, whereas the second and the third contain the average values for lending-only and deposit-mobilizing (savings-collecting and lending) MFIs.

The data show that the average loan portfolio is $5.02 million, the value of savings (if savings are collected) is $3.35 million, the average number of borrowers is 11,400, and the average number of depositors when savings are collected is 15,580. The cost of financial capital,

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[8] The dataset was collected from various publicly available online sources. They include reports from a previously available website called www.ratingfund.org, but this project was discontinued. Currently, MFIs reports are available via www.ratingfund2.org and www.ratinginitiative.org.

[9] Our data contain relatively few of the very large MFIs found in alternative datasets (e.g., mixmaret.org) but a comparison based on the medians indicate that our data are more representative of the industry as it avoids the larger MFIs bias existing in the alternative dataset. Moreover, alternative datasets do not permit to calculate the cost of capital and labor and cannot be used to analyze efficiency and input price elasticity.

which includes the cost of mobilizing deposits as well as loans, is 6%; the cost of labor, measured as the annual cost per employee, is $7,398; and the cost of capital, measured by the ratio of non-labor expenses to net fixed assets, is 2.79.

The impact of market competition and regulatory environment is captured by two indexes constructed from the information provided in the rating reports. These indexes range in value from 1 to 7, with larger values indicating more competition from other MFIs and banks and a more supportive regulatory environment (Mersland and Strøm, 2009).

The summary statistics show that the majority MFIs operate as NGOs (54%), followed by NBFIs (29%) and co-ops (13%). Only 2% of MFI are registered as banks, and among the deposit-taking institutions, microfinance banks represent 6%. The majority of MFI use the individual lending methodology (62%), whereas 22% use solidarity groups, and 16% use the village banking lending methodology.

## 5. Discussion of the results

### *5.1. Baseline model*

Table 2 contains the estimates of four specifications for the complete dataset of 989 annual observations from all MFIs worldwide. The first column contains the results from a model with a single output measured by the number of active borrowers, and the second column contains the results from a model with a single output measured by the dollar value of loans. The third and fourth columns contain the results from models with two outputs, loans and deposits, measured by the number of active clients in Model 3 and by the dollar value of loans and savings volume in Model 4.[10]

[10] Because lending-only MFIs have zero savings as output, to be able to take the log, we replace zero with 1 for the number of deposits and with 10 for value of deposits, as is typical in efficiency studies in banking focused on scope economies.

The overall model fit for the translog functional form is good and explains most of the variation in the data, with $R^2$ between 0.86 and 0.9. In all model specifications, almost all core variables - input prices, outputs and their derivatives - have the expected signs and are statistically significant at the 5% level or better (except for one interaction term in the first specification, which is not statistically significant). In addition, the majority of risk and time interactions are statistically significant in all specifications.

Estimated scale economies are presented at the bottom of each column. A comparison of these values produced by the four specifications is informative because measuring outputs by the number of clients better captures the outreach mission, whereas measuring outputs in dollars is more likely to identify efficiency in providing a larger volume of financial services; this efficiency is achieved by extending larger loans and collecting larger deposits. Because larger loans are cheaper to administer, differences in efficiency numbers between the two specifications suggest tradeoffs between sustainability and outreach.

The results in Table 2 shows that MFIs in the sample operate with increasing returns to scale because the coefficient on the output is less than one for all specifications. This finding indicates that larger MFIs are more efficient and that improvements in efficiency will come from MFI consolidation or expansion.

There are small differences in coefficient estimates between output measures, and this difference is more pronounced between the one-output models (0.13) compared to the specification with two outputs (0.04). The results from regressions with output measured in dollars produce slightly higher scale economies (0.89 for the one-output model and 0.85 for the two-output model), compared to the specifications where output is measured by the number of active clients (0.76 for the model with one output and 0.81 for the two-output model).

These differences in results are consistent with banking studies in which the production approach—which measures outputs by the number of accounts or transactions—produces higher economies of scale (smaller coefficients) than the intermediation approach (see Berger and Mester, 1997). For the case of MFIs, we interpret the results to indicate that serving more clients is more expensive than serving larger clients, a finding that is consistent with the microfinance literature (Hermes et al., 2011; Mersland and Strøm, 2010). The smaller coefficient in models measuring output(s) by the number of clients indicates that MFIs must move further down the cost curve and reach proportionally more clients rather than moving down the cost curve to extend more loans.

Similar to findings in the banking literature, we find that in MFIs, higher risk is associated with higher costs but only in the specifications where output is measured by the number of borrowers (Model 1) and by the number of borrowers and clients (Model 3). In particular, a one percent increase in delinquencies of 30 days or more (which is a very high increase in the risk profile of an MFI) is associated with a 17%(15%) increase in costs. However, an increase in this variable is not associated with higher costs in models with output(s) measured by the dollar value of loans and deposits. These results also indicate that it is costlier to reach more borrowers than to distribute larger loans.

The panel nature of the data allows us to study the role of technical progress in microfinance and answer questions such as whether costs decrease with time. Unfortunately, in this specification, we do not find that MFIs' costs decrease over time because the coefficient on time is not statistically significant in this specification.

Next, to study differences by business model, we divide the data into two subsamples – lending-only MFIs and savings-mobilizing MFIs (which lend and collect savings). Table 3 contains the results. The first two columns present results from estimated cost functions with observations from lending-only MFIs. In the first model, output is set at the number of active borrowers to capture the outreach mission of the MFI, and in the second model, the output is the loan portfolio in dollars. The scale economies' results are almost identical to those in the models estimated for the entire sample: 0.78 in the first model and 0.89 for the second.

In Table 3, the last two regressions are estimated with data from only savings-mobilizing MFIs. As for the lending-only MFI, here too outputs are measured by the number of active borrowers and active savers (depositors) to reflect the outreach mission on these MFIs (production approach) in Model 3, whereas in Model 4, outputs are the dollar value of the loan portfolio and deposits. Compared to the scale economies from the pooled sample, the coefficients on outputs are higher: 0.87 for the outreach-measuring approach (compared to 0.81) and 0.94 for the dollar value output specification (compared to 0.85). The smaller magnitude of the increasing returns to scale suggests that a smaller movement down the cost function is needed to reach the optimal scale for deposit-mobilizing MFIs than what we could infer from the overall sample used in the pooled regressions. Therefore, the results indicate that savings-mobilizing MFIs are closer to the optimal scale than lending-only MFIs, which is unsurprising because to obtain permission to mobilize deposits, MFIs must be much larger to meet entry capital requirements.

In the regressions by business model, we also find that a one percent increase in the riskiness of the portfolio is associated with an approximately 11% increase in costs in models with outputs measured in numbers. This number is smaller compared to the models for all MFIs, which showed increases of 15% and 17%. We find evidence for learning-by-doing in lending-only institutions (Models 1 & 2 in Table 3), with each additional year leading to an additional

3% decrease in cost in Model 1 in the outreach-measuring model (measuring output with the number of borrowers) and a 2% decrease in cost in Model 2, which measures output in dollars. However, there is still no evidence for learning-by-doing for savings-collecting MFIs, perhaps because most of these MFIs have recently transformed and are still in the initial stages of learning.

*5.2. Estimates with controls for MFIs' heterogeneity*

The results with MFI-specific and environmental controls included are presented in Table 4 for all MFIs and in Table 5 for MFIs by business model.

The results for the estimated scale economies with all MFIs included and with one output (Table 4, Models 1 & 2) are almost identical to the benchmark, falling within 0.01 or 0.02 points. In the regressions with two outputs (savings and loans), we find increasing returns to scale, with these variables actually higher than those in the specification without the additional controls. However, we note that these results may be because these control variables are not available for all MFIs, leading to a loss of approximately 100 observations. Similar to the results from the specifications in Table 3 and to results in previous banking studies, we find that the scale economies' coefficients are smaller for all specifications in Table 4 when the outputs are measured by the number of clients rather than the dollar volume.

In the regressions in Table 4, the impact of risk is now smaller in magnitude and is relevant only for the specification with one output (Models 1 & 2); it is not statistically significant in models with two-output specifications. The magnitude of this impact is smaller, with a one percentage point increase in loans delinquent by 30 days or more associated with a 10% increase in total costs compared to 17% increase in total costs presented in Table 2. Unlike the benchmark model, this coefficient is 0.06 and statistically significant in the specification with output measured in dollars. For Models 1 & 2, technical progress (learning-by-doing) appears to have an impact, with total costs initially decreasing and then increasing after 0.16 standard deviations from the mean year when the output is measured by the number of clients (Model 1).[11]

The environment in which MFIs operate affects their costs; this effect is mostly due to competitive pressure. We find that a more supportive environment is associated with lower costs only in the two-output model with deposits and loans measured in dollars. A more competitive environment is associated with lower costs in all specifications with outputs measured in dollars, whereas competition is associated with higher costs when outreach is accounted for by using the number of active clients as the output. If the cost of reaching more borrowers increases as competition increases, but the cost of distributing larger volume of loans decreases as competition increases, then the results may indicate that competition is likely associated with more funds for existing borrowers rather than with improved access for new borrowers.

The present specification indicates differences in cost only between NGOs (our base) and banks, with banks facing higher costs according to all models except for the two-output models with the number of active clients as outputs, which is the model that best reflects the objectives of MFIs. This difference likely reflects the cost of regulation. The dummy for regulation is statistically significant in all models except in the two-output model measured in dollars.

The lending methodology used by the MFIs affects costs, but the direction of the impact reflects the dual nature of MFIs' objectives and the possible tradeoffs between outreach and sustainability. Compared with MFIs using individual lending, the cost of MFIs using group-lending methods (village banking and solidarity lending) are higher when outputs are measured

[11] We find nonlinear risk impact in the one output models (Table 4, Model 1&2). For Model 1, the inflection point at which total cost starts to increase is 0.16 standard deviations because after taking the first derivative of the demeaned variable and setting it to zero we have $0.0137/[2*(-0.0043)] = 0.16$.

in dollars but lower when output is measured by the number of active clients (borrowers or borrowers and savers). These results once more suggest a tradeoff between serving many clients and having a large loan portfolio.

When we add the above-discussed controls to cost functions estimated with the subsamples of lending-only and deposit-mobilizing MFIs, we obtain slightly different results, as shown in Table 5. For the lending-only MFIs, we find similar scale economies estimates, but this time they are 0.01 to 0.02 points larger, not smaller, than the benchmark estimates by the business model without additional controls. The most interesting result concerns the group of deposit-mobilizing MFI, as we find that in this relatively small sample of 124 observations, MFIs operate at minimum costs and have achieved constant returns to scale, as the coefficients on the number of active borrowers and the number of active clients add to 0.96. We cannot reject the hypothesis that this coefficient equals one and conclude that deposit-mobilizing MFIs with a focus on outreach operate at (or very close to) minimum costs. However, we cannot confirm this result in the specification measuring outputs in dollars, whose results suggest that MFIs should still grow (their loan portfolios and savings) to achieve their optimal scale. These results are in line with estimates for scope economies (from both lending and mobilizing deposits) in MFIs, which found that deposit-mobilizing MFIs are more efficient, whereas lending-only MFIs have greater potential for costs savings by transforming to accept deposits (Hartarska et al., 2011).

Costs increase with risk independently of how output is measured (dollars or active clients) in both types of MFIs, but this time, the costs of an additional percentage point increase in delinquencies by 30 days or more is associated with 4-5 percent higher costs. As in the benchmark model, in the two-output models, the risk coefficient is statistically significant and larger (0.15 compared to 0.11) in the model without additional controls (Table 3, Model 3).

These results confirm previous findings that serving more clients is more expensive. However, although we again find evidence of technical progress, with cost falling by 2-3% per year in lending-only MFIs, we find higher costs in time in deposit-mobilizing MFIs when outputs are measured in dollars.

The results in Table 5 indicate that a better legal environment is associated with lower costs in models with output(s) measured in dollars but not in models with outputs measured in the number of clients. Competitive pressures decrease cost in lending-only MFIs with output measured in dollars and in deposit-mobilizing MFIs with outputs measured by the number of active clients. Again, for lending-only MFIs with output measured by the number of active borrowers, competitive pressure increased costs, suggesting that it is costlier to reach more borrowers than it is to lend larger sums. For MFIs operating in a country with a high competition, such as in Peru, where in 2009, this index was 6, the cost will be 12 percent higher (6+6) compared to MFIs in a country with an index of 4, such as Brazil in 2009. These results are consistent with the argument that the environments in which MFIs operate matter (Ahlin et al., 2010).

We find that compared to NGOs (the base group), co-ops have lower costs as lending-only MFIs when the number of borrowers is the output measure. Co-ops also have lower costs in deposit-mobilizing MFIs, whereas NBFIs only have lower costs in the model with active client measures of outputs. The magnitude differences are fairly large but should be interpreted with caution, as we have limited degrees of freedom with only 124 observations for deposit-mobilizing MFIs, and at least part of the results may be due to over-fitting the model. Moreover, the objective here is to measure scale, and the scale-measuring variable does not change significantly, regardless of whether we include these controls.

The dummy measuring whether the MFI is regulated by a banking regulatory body is statistically significant in all but the last regressions in Table 4 and suggest that compared to non-regulated, regulated MFIs have much higher (likely compliance-induced) costs ranging from 10% to a third higher. However, these results may capture a different effect, because regulation is associated with higher costs only in lending-only MFIs with output measured in numbers of borrowers when regressions are estimated by business model.

The results also indicate that the lending methodology is associated with differences in costs in that in models capturing the social mission (reflected in the use of the number of active clients as the output measure), MFIs employing group lending methods have lower costs compared to MFIs using individual lending (Models 1 & 3). However, in specifications with output(s) measured in dollars, MFIs using group lending have higher costs compared to MFIs using individual lending.

Our results conform to results obtained by studies exploring efficiency in MFIs in a single country. For example, for Mexico, we find a scale economy of 0.59 for a model with output measured as the number of active borrowers, which is comparable to the estimate of 0.64 for a sample of Mexico's popular savings and credit institutions, which is calculated using the stochastic frontier analysis presented in Paxton (2007).

*5.3. Own-price elasticities and elasticities of substitutions among inputs*

Elasticities of substitution between inputs and inputs' own-price elasticity are calculated for models with different output measures as well as by business model (lending-only and deposit-mobilizing MFIs); the results of these calculations are shown in Table 6. As expected, all own-price elasticities are negative and inelastic. We find smaller implied own-price elasticities than Allen own-price elasticities, as expected (Stiroh, 1999). The Allen own-price elasticities show that the financial capital is elastic in all groups of MFIs, whereas (physical) capital is elastic in lending-only MFIs but has unit price elasticity in savings-mobilizing MFIs. Labor, on the other hand, is inelastic in lending-only MFIs but elastic in savings-mobilizing MFIs.

The results indicate that all inputs - labor, financial and physical capital - are inelastic substitutes, which indicates that a very large change in the price of one input (say labor) will be needed to substitute it with another input (e.g., financial or physical capital). The relationship between physical and financial capital in deposit-collecting MFIs with output in dollars is the most inelastic, suggesting that only a very high cost of capital will induce these MFIs to use more of their physical infrastructure, such as purchasing a mobile banking unit to collect savings and distribute loans or renting rural office space once per week in place of maintaining a permanent office.

The least inelastic substitutes are physical capital and labor for the group of lending-only MFIs with loan output measured in dollars. This finding captures the fact that when the relative price of labor increases, these MFIs may try to use more ATM-type loan disbursement techniques. Overall, the calculated elasticities of substitutions by groups do not reveal a pattern related to either the output measure used or the business model employed.

The results indicate that MFIs can continue to lower their costs, as they have been doing with less physical capital (as physical capital was found to be elastic or unit elastic), and that more ATMs, point-of-sale systems, and mobile phones could be used. Other cost-lowering initiatives should continue to include partnerships with local post offices and existing banks. For example, in Ecuador, loan clients of D-MIRO can complete their transactions in Servipago, allowing the MFI to set up *light* branches without expensive security measurements and cash counters.

To further understand how MFIs operate in various countries, we compare the elasticities for MFIs operating in two very different countries: Peru and Brazil.[12] For example, Peruvian MFIs exhibit the typical inelastic substitution effect between labor and financial capital, whereas Brazilian MFIs have an extremely inelastic complementary relationship between labor and financial capital, even in the outreach measuring models with number of active clients as outputs even. These differences are most likely due to the typical competitive environment for Peruvian MFIs. In Brazil, on the other hand, most lending is conducted through downscaling (lending through units within existing financial institutions), suggesting that Brazilian MFIs do not have to invest in new infrastructure but use already-existing infrastructure; thus, both labor and complementary financial capital are needed to reach more borrowers.[13]

*5.4. Optimal scale*

We can compute optimal scales from the above estimates by taking the derivative of the total cost with respect to output and setting it to one because when this coefficient is one, the organizations achieve constant returns to scale. Using this method, we compute the optimal scale by group. We discuss only two results that fall within the sample because in most specifications, the optimal scale values fall outside the range of the output, and although we technically could use the maximum value as a reference point, doing so is not very informative.

For lending-only MFIs, we find that the optimal scale is approximately 9 million dollars in the loan portfolio, which is more than twice the mean value of the sample of 4.62 million but smaller than the maximum value of 34.6 million, suggesting that at least some MFIs in the sample are operating above the optimal scale. For savings-collecting MFIs, we obtain within the

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[12] Peru and Brazil are different in terms of their size, population, and microfinance development, with Peru ranked in the top three countries and Brazil in the bottom three countries in Latin America by the level of development of the microfinance sector.
[13] Regional elasticities are available from the authors.

sample only one value, which indicates that costs are minimized at approximately 34,260 borrowers, which is twice the mean of 15,690 borrowers but much smaller than the 134,770 borrowers of the largest observation. As previously noted, the average deposit-mobilizing MFIs must make a much greater effort to reach the optimum number of borrowers (twice the mean) compared with the average lending-only MFIs, for which costs are minimized at half the mean of the loan portfolio in the sample. Again, we find that reaching more borrowers is more difficult than generating a larger loan portfolio. Therefore, efficiency measures taking into account the outreach mission or the number of clients reached appear to be preferable and should be encouraged.

## 6. Conclusion

Efficiency analysis helps to understand how MFIs use inputs, such as labor, capital and financial capital, to produce outputs, such as loans and deposits. Under the structured approach to efficiency with cost function estimation, we assume that all MFIs strive to minimize their costs and reach as many clients as possible, thus meeting the needs of microfinance clients who have entrepreneurial ability but lack capital. Because outreach is the most important mission of MFIs, it is best met by ensuring the highest cost savings by achieving scale efficiency. Surprisingly, no study thus far has focused exclusively on identifying this sector's scale economies and how MFIs use inputs to achieve their goals.

This study is the first to estimate scale economies and elasticities of substitution among inputs in MFIs using a sample of 989 annual cross-country observations. The results indicate substantial cost savings from achieving the optimal scale for the average MFI in the sample, which has a scale economy coefficient of 0.77 or higher. The calculated elasticities of substitution suggest that only very high changes in input prices will be sufficient to induce the substitution of one type of input with another and that deposit–mobilizing MFIs may be operating at their optimal scale if their focus is on outreach.

The results that the microfinance industry has increasing returns to scale suggest the need to grow and consolidate to benefit from lower per unit costs. Staying small does not seem optimal for MFIs interested in reducing their costs. The results are supportive of the existing push toward the transformation of NGO-MFIs into regulated deposit-mobilizing MFIs because as we find, these MFIs are most likely to be scale efficient. We find evidence for technical progress in lending-only MFIs and not in their savings-mobilizing counterparts. This finding might be a result of regulators continually imposing regulations that affect MFIs' costs, neutralizing the effect of technical progress. With an increased scale of MFIs, management and governance challenges become even more important and must be addressed (Mersland and Strøm, 2009). Policy makers should focus on building the governance and management capacity in growing MFIs and study how they may be connected to scale (dis)economies.

To grow, MFIs must secure more funding from lenders or depositors. This need is likely to push MFIs in a more commercial direction. Because we do find that serving more borrowers is costlier than extending larger loans, the potential for a mission drift with commercialization in the sector must be recognized. Therefore, the debate on the tradeoffs from mission drift and efficiency is likely to continue.

Industry consolidation could bring about future cost savings beneficial to both investors and individuals as well as offering a benefit to MFI clients who have entrepreneurial skills but lack access to financial services. An example of a recent takeover is that by Equity Bank in Kenya of UML in Uganda. Although few consolidations have been observed, given the increased competition and potential for scale economies, more takeovers in the future would not be surprising.

Table 1. Summary Statistics

| Variable | All MFIs | Lending Only MFIs | Deposit Mobilizing MFIs |
|---|---|---|---|
| Total Cost (US$ Millions) | 1.2 | 1.12 | 1.43 |
| | (1.20) | (1.10) | (1.55) |
| $Y_1$($) - Loan Portfolio (US$ Millions) | 5.02 | 4.62 | 6.1 |
| | (5.76) | (5.25) | (6.87) |
| $Y_2$ ($) - Deposits (US$ Millions) | 0.88 | | 3.35 |
| | (2.90) | | (4.85) |
| $Y_1$(#) - Number of Borrowers (Thousands) | 11.39 | 10.11 | 14.69 |
| | (21.31) | (20.00) | (24.10) |
| $Y_2$(#) - Number of Savers (Thousands) | 2.91 | | 15.58 |
| | (11.25) | | (21.97) |
| Price of Labor | 7,398 | 8,020 | 5,697 |
| | (4,316) | (4,304) | (3,844) |
| Price of Fixed Capital | 2.79 | 2.97 | 2.26 |
| | (3.2) | (3.33) | (2.74) |
| Price of Financial Capital | 0.06 | 0.06 | 0.06 |
| | (0.05) | (0.05) | (0.05) |
| Risk - Loans Overdue > 30 days/Loan Portfolio | 0.07 | 0.06 | 0.09 |
| | (0.10) | (0.09) | (0.11) |
| Legal Environment | 4.25 | 4.22 | 4.32 |
| | (1.57) | (1.64) | (1.36) |
| Market Competition | 4.39 | 4.48 | 4.11 |
| | (1.55) | (1.55) | (1.49) |
| Regulated (by Central bank laws) | 0.27 | 0.14 | 0.63 |
| | (0.45) | (0.35) | (0.48) |
| *Type* | | | |
| BANK | 0.02 | 0.01 | 0.06 |
| | (0.15) | (0.09) | (0.24) |
| NBFI | 0.29 | 0.26 | 0.35 |
| | (0.45) | (0.44) | (0.47) |
| NGO | 0.54 | 0.70 | 0.11 |
| | (0.50) | (0.46) | (0.31) |
| COOP | 0.13 | 0.01 | 0.45 |
| | (0.34) | (0.11) | (0.49) |
| Other | 0.02 | 0.02 | 0.01 |
| | (0.14) | (0.15) | (0.13) |
| *Loan Method* | | | |
| Bank | 0.15 | 0.17 | 0.09 |
| | (0.36) | (0.38) | (0.28) |
| Solidarity Groups | 0.22 | 0.23 | 0.18 |
| | (0.42) | (0.42) | (0.38) |
| Individual Loans | 0.62 | 0.59 | 0.72 |
| | (0.48) | (0.49) | (0.44) |
| Total Assets (US$ Millions) | 5.90 | 5.30 | 7.47 |
| | (6.60) | (5.96) | (7.89) |
| Observations | 989 | 725 | 260 |

Table 2 Pooled Regression Results [a]

| Variable | One Output (Lending Only) | | Two Outputs (Deposit Mobilizing) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Y (#) | Y($) | Y1&Y2 (#) | Y1&Y2($) |
| Constant | 0.318** | -0.679*** | 0.569*** | -0.648*** |
| | (0.1356) | (0.111) | (0.1621) | (0.122) |
| $\ln(Y_1)$ (Loans in #) | 0.761*** | | 0.690*** | 0.746*** |
| | (0.026) | | (0.056) | (0.034) |
| $\ln(Y_1)$ (Loans in $) | | 0.887*** | | |
| | | (0.019) | | |
| $\ln(Y_2)$ (Deposits in #) | | | 0.118*** | |
| | | | (0.041) | |
| $\ln(Y_2)$ (Deposits in $) | | | | 0.106*** |
| | | | | (0.022) |
| ln(PLabor[b]) | 0.430*** | 0.404*** | 0.379*** | 0.347*** |
| | (0.005) | (0.005) | (0.009) | (0.007) |
| ln(PCapital[b]) | 0.170*** | 0.194*** | 0.193*** | 0.231*** |
| | (0.005) | (0.005) | (0.009) | (0.007) |
| $\ln(Y_1)^2$ | 0.019 | 0.086*** | 0.022 | 0.088*** |
| | (0.016) | (0.015) | (0.016) | (0.016) |
| $\ln(Y_2)^2$ | | | 0.0211* | 0.0150*** |
| | | | (0.0125) | (0.0033) |
| $\ln(Y_1)*\ln(Y_2)$ | | | -0.0125* | -0.0108*** |
| | | | (0.0065) | (0.0026) |
| $\ln(PLabor)^2$ | 0.069*** | 0.062*** | 0.063*** | 0.056*** |
| | (0.003) | (0.004) | (0.004) | (0.004) |
| $\ln(PCapital)^2$ | 0.061*** | 0.069*** | 0.057*** | 0.070*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| ln(PLabor)*ln(PCapital) | -0.035*** | -0.036*** | -0.031*** | -0.035*** |
| | (0.002) | (0.003) | (0.003) | (0.002) |
| $\ln(Y_1)$*ln(PLabor) | 0.007** | -0.0287*** | 0.009*** | -0.022*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $\ln(Y_2)$*ln(PLabor) | | | -0.0100*** | -0.0065*** |
| | | | (0.0011) | (0.0006) |
| $\ln(Y_1)$*ln(PCapital) | -0.012*** | 0.018*** | -0.015*** | 0.014*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $\ln(Y_2)$*ln(PCapital) | | | 0.005*** | 0.004*** |
| | | | (0.001) | (0.001) |
| ln(Risk) | 0.166*** | -0.006 | 0.150*** | -0.042 |
| | (0.024) | (0.018) | (0.035) | (0.026) |
| $\ln(Risk)^2$ | 0.009 | -0.020** | -0.002 | -0.025** |
| | (0.012) | (0.010) | (0.013) | (0.010) |
| ln(Risk)*ln(PLabor) | -0.013*** | -0.019*** | -0.010*** | -0.014*** |
| | (0.003) | (0.002) | (0.003) | (0.002) |
| ln(Risk)*ln(PCapital) | 0.002 | 0.007*** | 0.0002 | 0.004 |
| | (0.003) | (0.002) | (0.003) | (0.0024) |
| ln(Risk)* $\ln(Y_1)$ | 0.025*** | 0.005 | 0.026*** | 0.005 |
| | (0.009) | (0.008) | (0.010) | (0.008) |

[a] All the variables in this table, including the variables in the subsequent tables, are demeaned to facilitate the calculation of the scale economy.
[b] Prices of labor and financial capital are normalized (divided) by the price of physical capital and labeled as PLabor and PCapital respectively.

| Variable | One Output (Lending Only) | | Two Outputs (Deposit Mobilizing) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Y (#) | Y($) | Y1&Y2 (#) | Y1&Y2($) |
| ln(Risk)* ln($Y_2$) | | | 0.004 | -0.001 |
| | | | (0.004) | (0.002) |
| T | -0.016 | -0.012 | -0.011 | -0.004 |
| | (0.011) | (0.009) | (0.023) | (0.014) |
| $T^2$ | 0.018*** | 0.008* | 0.013** | 0.007* |
| | (0.006) | (0.004) | (0.006) | (0.004) |
| T*ln(PLabor) | -0.001 | -0.001 | 0.0003 | 0.001 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| T*ln(PCapital) | 0.008*** | 0.009*** | 0.010*** | 0.007*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| T*ln($Y_1$) | -0.011* | -0.006 | 0.002 | -0.003 |
| | (0.007) | (0.006) | (0.007) | (0.006) |
| T*ln($Y_2$) | | | 0.002 | 0.0003 |
| | | | (0.003) | (0.001) |
| T* ln(Risk) | 0.008 | 0.014*** | -0.002 | 0.015*** |
| | (0.006) | (0.005) | (0.006) | (0.005) |
| Country Dummy | Yes | Yes | Yes | Yes |
| Observations | 970 | 989 | 844 | 985 |
| Cost R-Squared | 0.860 | 0.906 | 0.891 | 0.907 |
| Economies of Scale | 0.76 | 0.89 | 0.81 | 0.85 |

Robust standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3 Regression Results by Business Model (Group)

| Variable | Lending-only MFIs | | Deposit-mobilizing MFIs | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Loans (#) | Loans ($) | Loans&Deposits (#) | Loans&Deposits ($) |
| Constant | 0.376*** | -0.641*** | 1.154*** | 1.879*** |
| | (0.130) | (0.116) | (0.416) | (0.398) |
| $\ln(Y_1)$ (Loans in #) | 0.778*** | | 0.583*** | |
| | (0.030) | | (0.081) | |
| $\ln(Y_1)$ (Loans in $) | | 0.887*** | | 0.726*** |
| | | (0.024) | | (0.054) |
| $\ln(Y_2)$ (Deposits in #) | | | 0.285*** | |
| | | | (0.072) | |
| $\ln(Y_2)$ (Deposits in $) | | | | 0.210*** |
| | | | | (0.040) |
| ln(PLabor[a]) | 0.457*** | 0.438*** | 0.366*** | 0.323*** |
| | (0.006) | (0.005) | (0.012) | (0.009) |
| ln(PCapital[a]) | 0.161*** | 0.174*** | 0.187*** | 0.252*** |
| | (0.005) | (0.005) | (0.014) | (0.010) |
| $\ln(Y_1)^2$ | -0.001 | 0.081*** | 0.198*** | 0.039 |
| | (0.020) | (0.018) | (0.048) | (0.059) |
| $\ln(Y_2)^2$ | | | 0.1143*** | 0.048*** |
| | | | (0.0286) | (0.014) |
| $\ln(Y_1)*\ln(Y_2)$ | | | -0.1477*** | -0.018 |
| | | | (0.0299) | (0.024) |
| $\ln(PLabor)^2$ | 0.064*** | 0.058*** | 0.070*** | 0.062*** |
| | (0.004) | (0.004) | (0.007) | (0.006) |
| $\ln(PCapital)^2$ | 0.052*** | 0.063*** | 0.064*** | 0.085*** |
| | (0.003) | (0.003) | (0.007) | (0.005) |
| ln(PLabor)*ln(PCapital) | -0.033*** | -0.036*** | -0.029*** | -0.034*** |
| | (0.003) | (0.003) | (0.005) | (0.004) |
| $\ln(Y_1)$*ln(PLabor) | 0.002 | -0.032*** | 0.036*** | 0.018*** |
| | (0.003) | (0.004) | (0.008) | (0.006) |
| $\ln(Y_2)$*ln(PLabor) | | | -0.0134* | -0.0228*** |
| | | | (0.008) | (0.004) |
| $\ln(Y_1)$*ln(PCapital) | -0.002 | 0.023*** | -0.035*** | -0.026*** |
| | (0.003) | (0.003) | (0.010) | (0.008) |
| $\ln(Y_2)$*ln(PCapital) | | | -0.013 | 0.019*** |
| | | | (0.010) | (0.005) |
| ln(Risk) | 0.106*** | -0.032 | 0.105** | -0.011 |
| | (0.027) | (0.021) | (0.051) | (0.045) |
| $\ln(Risk)^2$ | -0.004 | -0.023** | 0.0001 | -0.020 |
| | (0.011) | (0.012) | (0.023) | (0.018) |
| ln(Risk)*ln(PLabor) | -0.009*** | -0.014*** | -0.014** | -0.011** |
| | (0.003) | (0.003) | (0.006) | (0.004) |
| ln(Risk)*ln(PCapital) | 0.005* | 0.009*** | -0.011 | -0.008 |
| | (0.003) | (0.003) | (0.007) | (0.005) |
| ln(Risk)*$\ln(Y_1)$ | 0.009 | 0.001 | 0.011 | -0.008 |
| | (0.011) | (0.010) | (0.023) | (0.0120) |
| ln(Risk)*$\ln(Y_2)$ | | | 0.013 | 0.007 |
| | | | (0.022) | (0.015) |

[a] Prices of labor and financial capital are normalized (divided) by the price of physical capital and labeled as PLabor and PCapital respectively.

| Variable | Lending-only MFIs (1) Loans (#) | (2) Loans ($) | Deposit-mobilizing MFIs (3) Loans&Deposits (#) | (4) Loans&Deposits ($) |
|---|---|---|---|---|
| T | -0.033*** | -0.017* | 0.014 | 0.032 |
| | (0.012) | (0.010) | (0.024) | (0.020) |
| $T^2$ | 0.005 | 0.002 | 0.018 | 0.017* |
| | (0.006) | (0.005) | (0.017) | (0.010) |
| T*ln(PLabor) | 0.001 | 0.002 | -0.001 | 0.004 |
| | (0.002) | (0.002) | (0.005) | (0.003) |
| T*ln(PCapital) | 0.008*** | 0.007*** | 0.014** | 0.0002 |
| | (0.002) | (0.002) | (0.006) | (0.004) |
| T*ln($Y_1$) | -0.001 | -0.001 | -0.069*** | -0.001 |
| | (0.008) | (0.007) | (0.019) | (0.016) |
| T*ln($Y_2$) | | | 0.055*** | -0.016** |
| | | | (0.018) | (0.008) |
| T*ln(Risk) | -0.005 | 0.020*** | 0.014 | 0.004 |
| | (0.007) | (0.006) | (0.015) | (0.012) |
| Country Dummy | Yes | Yes | Yes | Yes |
| Observations | 688 | 725 | 156 | 260 |
| Cost R-Square | 0.883 | 0.917 | 0.958 | 0.910 |
| Economies of Scale | 0.78 | 0.89 | 0.87 | 0.94 |

Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4 Regressions with Additional Controls for All MFIs

| Variable | One Output (Lending Only) | | Two Outputs (Deposit Mobilizing) | |
|---|---|---|---|---|
| | (1) Loans (#) | (2) Loans ($) | (3) Loans&Deposits (#) | (4) Loans&Deposits ($) |
| Constant | 0.175 | -0.474*** | 0.034 | -0.374** |
| | (0.167) | (0.136) | (0.207) | (0.150) |
| $\ln(Y_1)$ (Loans in #) | 0.709*** | | 0.581*** | |
| | (0.029) | | (0.066) | |
| $\ln(Y_1)$ (Loans in $) | | 0.881*** | | 0.714*** |
| | | (0.021) | | (0.039) |
| $\ln(Y_2)$ (Deposits in #) | | | 0.178*** | |
| | | | (0.043) | |
| $\ln(Y_2)$ (Deposits in $) | | | | 0.114*** |
| | | | | (0.024) |
| ln(Labor[a]) | 0.425*** | 0.40*** | 0.374*** | 0.345*** |
| | (0.005) | (0.005) | (0.010) | (0.007) |
| ln(Capital[a]) | 0.167*** | 0.192*** | 0.190*** | 0.231*** |
| | (0.005) | (0.005) | (0.010) | (0.007) |
| $\ln(Y_1)^2$ | -0.025 | 0.075*** | 0.006 | 0.078*** |
| | (0.017) | (0.015) | (0.018) | (0.016) |
| $\ln(Y_2)^2$ | | | 0.044*** | 0.016*** |
| | | | (0.013) | (0.004) |
| $\ln(Y_1)*\ln(Y_2)$ | | | -0.028*** | -0.013*** |
| | | | (0.008) | (0.003) |
| $\ln(PLabor)^2$ | 0.073*** | 0.068*** | 0.067*** | 0.061*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| $\ln(PCapital)^2$ | 0.0652*** | 0.073*** | 0.057*** | 0.073*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| ln(PLabor)*ln(PCapitl) | -0.037*** | -0.039*** | -0.030*** | -0.036*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $\ln(Y_1)$*ln(PLabor) | 0.004 | -0.033*** | 0.005 | -0.026*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $\ln(Y_2)$*ln(PLabor) | | | -0.009*** | -0.006*** |
| | | | (0.001) | (0.001) |
| $\ln(Y_1)$*ln(PCapital) | -0.014*** | 0.020*** | -0.017*** | 0.014*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $\ln(Y_2)$*ln(PCapital) | | | 0.005*** | 0.005*** |
| | | | (0.001) | (0.006) |
| ln(Risk) | 0.093*** | 0.064*** | 0.060 | 0.0003 |
| | (0.026) | (0.020) | (0.040) | (0.028) |
| $\ln(Risk)^2$ | 0.002 | 0.009 | -0.008 | 0.004 |
| | (0.012) | (0.010) | (0.013) | (0.010) |
| ln(Risk)*ln(PLabor) | -0.013*** | -0.019*** | -0.009*** | -0.014*** |
| | (0.003) | (0.003) | (0.003) | (0.002) |
| ln(Risk)*ln(PCapital) | 0.001 | 0.005* | -0.001 | 0.001 |
| | (0.003) | (0.003) | (0.003) | (0.002) |
| ln(Risk)* $\ln(Y_1)$ | 0.007 | -0.003 | 0.011 | -0.003 |
| | (0.010) | (0.008) | (0.010) | (0.008) |
| ln(Risk)* $\ln(Y_2)$ | | | -0.001 | -0.005** |
| | | | (0.005) | (0.002) |

[a] Prices of labor and financial capital are normalized (divided) by the price of physical capital and labeled as PLabor and PCapital respectively.

| Variable | One Output (Lending Only) (1) Loans (#) | (2) Loans ($) | Two Outputs (Deposit Mobilizing) (3) Loans&Deposits (#) | (4) Loans&Deposits ($) |
|---|---|---|---|---|
| T | -0.004 | -0.009 | 0.038 | -0.004 |
| | (0.011) | (0.009) | (0.028) | (0.015) |
| $T^2$ | 0.014*** | 0.007* | 0.005 | 0.006 |
| | (0.005) | (0.004) | (0.006) | (0.004) |
| T*ln(PLabor) | -0.0001 | -0.001 | 0.001 | 0.001 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| T*ln(PCapital) | 0.008*** | 0.009*** | 0.011*** | 0.008*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| T*ln($Y_1$) | -0.006 | -0.007 | -0.001 | -0.002 |
| | (0.007) | (0.006) | (0.008) | (0.006) |
| T*ln($Y_2$) | | | 0.009*** | 0.0002 |
| | | | (0.003) | (0.001) |
| T* ln(Risk) | 0.005 | 0.014*** | -0.005 | 0.0150*** |
| | (0.006) | (0.005) | (0.006) | (0.005) |
| Legal Environment | 0.003 | -0.024 | 0.028 | -0.028* |
| | (0.019) | (0.016) | (0.019) | (0.016) |
| Market Competition | 0.030* | -0.040*** | 0.037** | -0.033** |
| | (0.017) | (0.014) | (0.018) | (0.014) |
| Bank Regulation | 0.336*** | 0.116** | 0.230*** | 0.055 |
| | (0.057) | (0.048) | (0.063) | (0.049) |
| Bank | 0.426*** | 0.375*** | -0.082 | 0.279** |
| | (0.164) | (0.132) | (0.293) | (0.133) |
| NBFI | -0.029 | 0.045 | 0.059 | 0.059 |
| | (0.060) | (0.050) | (0.063) | (0.050) |
| Coop | 0.074 | -0.038 | -0.125 | -0.217*** |
| | (0.071) | (0.059) | (0.135) | (0.074) |
| Others | -0.097 | 0.065 | 0.187 | 0.191* |
| | (0.123) | (0.102) | (0.131) | (0.101) |
| Village Bank Loan | -0.399*** | 0.257*** | -0.405*** | 0.277*** |
| | (0.058) | (0.047) | (0.060) | (0.047) |
| Solidarity Loans | -0.370*** | 0.166*** | -0.339*** | 0.198*** |
| | (0.049) | (0.041) | (0.050) | (0.04) |
| Country | Yes | Yes | Yes | Yes |
| Observations | 859 | 875 | 746 | 875 |
| Cost R-Squared | 0.88 | 0.92 | 0.90 | 0.91 |
| Economies of Scale | 0.71 | 0.88 | 0.76 | 0.83 |

Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5. Regressions with Additional Controls, by Business Model (Groups)

| Variable | Lending-only MFIs | | Deposit-mobilizing MFIs | |
|---|---|---|---|---|
| | Loans (#) | Loans ($) | Loans&Deposits (#) | Loans&Deposits ($) |
| Constant | 0.119 | -0.381** | 1.572*** | 1.152*** |
| | (0.168) | (0.150) | (0.595) | (0.243) |
| $\ln(Y_1)$ (Loans in #) | 0.782*** | | 0.498*** | |
| | (0.032) | | (0.135) | |
| $\ln(Y_1)$ (Loans in $) | | 0.901*** | | 0.696*** |
| | | (0.024) | | (0.057) |
| $\ln(Y_2)$ (Deposits in #) | | | 0.467*** | |
| | | | (0.081) | |
| $\ln(Y_2)$ (Deposits in $) | | | | 0.179*** |
| | | | | (0.041) |
| ln(Labor[a]) | 0.444*** | 0.430*** | 0.370*** | 0.325*** |
| | (0.007) | (0.006) | (0.013) | (0.008) |
| ln(Capital[a]) | 0.162*** | 0.174*** | 0.169*** | 0.247*** |
| | (0.006) | (0.005) | (0.015) | (0.011) |
| $\ln(Y_1)^2$ | -0.030 | 0.067*** | 0.279*** | -0.044 |
| | (0.020) | (0.018) | (0.056) | (0.059) |
| $\ln(Y_2)^2$ | | | 0.145*** | 0.054*** |
| | | | (0.029) | (0.015) |
| $\ln(Y_1)*\ln(Y_2)$ | | | -0.143*** | -0.016 |
| | | | (0.031) | (0.025) |
| $\ln(\text{Labor})^2$ | 0.067*** | 0.062*** | 0.075*** | 0.067*** |
| | (0.005) | (0.005) | (0.009) | (0.007) |
| $\ln(\text{Capital})^2$ | 0.048*** | 0.059*** | 0.089*** | 0.137*** |
| | (0.003) | (0.003) | (0.012) | (0.007) |
| ln(PLabor)*ln(Capitl) | -0.028*** | -0.033*** | -0.044*** | -0.057*** |
| | (0.003) | (0.003) | (0.009) | (0.006) |
| $\ln(Y_1)$*ln(PLabor) | -0.004 | -0.036*** | 0.039*** | 0.025*** |
| | (0.004) | (0.004) | (0.009) | (0.007) |
| $\ln(Y_2)$*ln(PLabor) | | | -0.015** | -0.029*** |
| | | | (0.008) | (0.004) |
| $\ln(Y_1)$*ln(PCapital) | -0.001 | 0.026*** | -0.040*** | -0.036*** |
| | (0.003) | (0.003) | (0.010) | (0.009) |
| $\ln(Y_2)$*ln(PCapital) | | | -0.015 | 0.032*** |
| | | | (0.009) | (0.005) |
| ln(Risk) | 0.047* | 0.040* | 0.149** | 0.036 |
| | (0.027) | (0.022) | (0.062) | (0.042) |
| $\ln(\text{Risk})^2$ | -0.014 | 0.003 | 0.038 | -0.008 |
| | (0.014) | (0.012) | (0.026) | (0.016) |
| ln(Risk)*ln(PLabor) | -0.012*** | -0.016*** | -0.006 | -0.003 |
| | (0.003) | (0.003) | (0.007) | (0.004) |
| ln(Risk)*ln(PCapital) | 0.008*** | 0.010*** | -0.019** | -0.020*** |
| | (0.003) | (0.003) | (0.008) | (0.006) |
| ln(Risk)* $\ln(Y_1)$ | -0.011 | -0.005 | 0.020 | -0.061*** |
| | (0.012) | (0.010) | (0.030) | (0.016) |
| ln(Risk)* $\ln(Y_2)$ | | | -0.031 | 0.032** |
| | | | (0.022) | (0.013) |
| T | -0.033*** | -0.019* | 0.006 | 0.031* |

[a] Prices of labor and financial capital are normalized (divided) by the price of physical capital and labeled as PLabor and PCapital respectively.

| Variable | Lending-only MFIs | | Deposit-mobilizing MFIs | |
|---|---|---|---|---|
| | Loans (#) | Loans ($) | Loans&Deposits (#) | Loans&Deposits ($) |
| | (0.013) | (0.010) | (0.032) | (0.018) |
| $T^2$ | 0.001 | -0.001 | 0.028* | 0.003 |
| | (0.006) | (0.005) | (0.015) | (0.007) |
| T*ln(PLabor) | 0.001 | 0.002 | 0.003 | 0.002 |
| | (0.002) | (0.002) | (0.005) | (0.003) |
| T*ln(PCapital) | 0.008*** | 0.008*** | 0.0079 | 0.003 |
| | (0.002) | (0.002) | (0.0064) | (0.004) |
| T*ln($Y_1$) | 0.002 | 0.003 | -0.093*** | -0.002 |
| | (0.008) | (0.007) | (0.020) | (0.013) |
| T*ln($Y_2$) | | | 0.048** | -0.002 |
| | | | (0.018) | (0.007) |
| T* ln(Risk) | -0.004 | 0.018*** | 0.019 | 0.005 |
| | (0.007) | (0.006) | (0.014) | (0.009) |
| Legal Environment | 0.019 | -0.041** | 0.040 | -0.076*** |
| | (0.021) | (0.019) | (0.053) | (0.028) |
| Market competition | 0.057*** | -0.031* | -0.175*** | 0.002 |
| | (0.021) | (0.018) | (0.032) | (0.020) |
| Bank regulation | 0.264*** | 0.014 | 0.293 | 0.014 |
| | (0.072) | (0.063) | (0.189) | (0.087) |
| Bank | -0.190 | 0.129 | | 0.147 |
| | (0.292) | (0.267) | | (0.147) |
| NBFI | 0.023 | 0.048 | -1.183*** | -0.155 |
| | (0.068) | (0.060) | (0.368) | (0.122) |
| Coop | -0.816** | 0.152 | -1.062*** | -0.581*** |
| | (0.350) | (0.185) | (0.361) | (0.127) |
| Others | 0.013 | 0.183 | | -0.509** |
| | (0.137) | (0.118) | | (0.235) |
| Village Bank Loan | -0.412*** | 0.298*** | -0.649** | 0.356*** |
| | (0.064) | (0.053) | (0.271) | (0.099) |
| Solidarity Group Loan | -0.335*** | 0.299*** | -0.003 | -0.056 |
| | (0.053) | (0.048) | (0.120) | (0.075) |
| Country | Yes | Yes | Yes | Yes |
| | | | | |
| Observations | 622 | 661 | 124 | 214 |
| Cost R-Squared | 0.90 | 0.92 | 0.96 | 0.90 |
| Economies of scale | 0.78 | 0.90 | 0.96 | 0.88 |

Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6 Allen Own-, Cross-Price, and Implied Own-Price Elasticities for Four Output Specifications, by Business Model

| Elasticity | Lending-only MFIs | | Deposit-mobilizing MFIs | |
|---|---|---|---|---|
| | (1) Loans(#) | (2) Loans($) | (3) Loans&Deposits (#) | (4) Loans&Deposits ($) |
| Allen LK | 0.825 | 0.877 | 0.722 | 0.805 |
| Allen LF | 0.562 | 0.509 | 0.655 | 0.608 |
| Allen KF | 0.676 | 0.530 | 0.620 | 0.463 |
| Allen LL | -0.832 | -0.840 | -1.206 | -1.300 |
| Allen KK | -1.354 | -1.363 | -1.003 | -0.996 |
| Allen FF | -3.215 | -2.815 | -2.150 | -1.706 |
| Own LL | -0.384 | -0.395 | -0.397 | -0.438 |
| Own KK | -0.616 | -0.617 | -0.506 | -0.489 |
| Own FF | -0.537 | -0.446 | -0.523 | -0.420 |

## References

Ahlin, C., Lin J., Maio, M., 2011. Where does microfinance flourish? Microfinance institution performance in macroeconomic context, Journal of Development Economics 95, 105-120.

Altunbas,Y., Liu, M.H., Molyneux, P., Seth, R., 2000. Efficiency and risk in Japanese banking. Journal of Banking and Finance 24, 1605-1628.

Balkenhol, B., 2008. Microfinance and Public Policy: Outreach Performance and Efficiency. Houndsmill, England.

Berger, A.N., 2007. International comparisons of banking efficiency. Financial Markets, Institutions & Instruments 16, 119-144.

Berger, A., Humphrey, D. 1991. The dominance of inefficiencies over scale and product mix economies in banking. Journal of Monetary Economics 28, 117-148.

Berger, A.N., Mester, L.J., 2003. Explaining the dramatic changes in performance of U.S. banks: Technical change, deregulation, and dynamic changes in competition. Journal of Financial Intermediation 12, 57-95.

Berger, A.N., Mester, L.J., 1997. Inside the black box: What explains differences in the efficiencies of financial institutions. Journal of Banking and Finance 21, 895-947.

Bos, J.W.B., Kool, C.J.M., 2006. Bank Efficiency: The role of bank strategy and the local markets conditions. Journal of Banking and Finance 30, 1953-1974.

Caudill, S., Gropper, D., Hartarska V., 2009 Which microfinance institutions are becoming more cost-efficient with time? Evidence from a mixture model. Journal of Money, Credit, and Banking 41, 651-672.

Cull, R., Demirguc-Kunt, A, Morduch J., 2007. Financial performance and outreach a global analysis of leading MFIs. The Economic Journal 117, F107-F133.

Daley-Harris, S., 2009. State of the Microcredit Summit Campaign Report 2009. Microcredit Summit. Washington, D.C.

Fries, S., Taci, A., 2005. Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. Journal of Banking and Finance 29, 55-81.

Gutierrez-Nieto, B., Serrano-Cinca, C., Mar, M., 2007. Microfinance institutions and efficiency. Omega: The International Journal of Management Science 35, 131-142.

Hartarska, V., Parmeter, C., and Nadolnyak, D., 2010. Economies of Scope for Microfinance: Differences Across Output Measures, Pacific Economic Review.15:4, 464–481.

Hartarska, V., Parameter, C., Nadolnyak D., 2011. Economies of scope for microfinance: Differences across output measures. American Journal of Agricultural Economics 93, 389-398.

Hartarska V., Mersland, R., 2012. What governance mechanisms promote efficiency in reaching poor clients? Evidence from rated MFIs. European Financial Management, 18, 218-239.

Hartarska V., Nadolnyak, D., 2007. Do regulated microfinance institutions achieve better sustainability and outreach? Cross-country evidence. Applied Economics 39, 1207-1222.

Hermes, N., Lensink, R., Meesters, A., 2011. Outreach and efficiency of microfinance institutions. World Development 39, 938-48.

Hughes, J, Mester, L., 2008a. Efficiency in banking: Theory practice and evidence. Working paper 08-1, Federal Reserve Bank of Philadelphia.

Hughes, J.P., Mester, L.J., 2008b, Bank capitalization and cost: Evidence of scale economies in risk management and signaling. Review of Economics and Statistics 80, 314-325.

Lang, G., Welzel, P., 1996. Efficiency and technical progress in banking Empirical results for a panel of German cooperative banks. Journal of Banking and Finance 20, 1003-1023.

León-Ledesma, M.A., McAdam, P., Willman, A., 2010. Identifying the elasticity of substitution with biased technical change. American Economic Review 100, 1330–1357.

Mersland, R., Strøm, R.Ø., 2009. Performance and governance in microfinance institutions. Journal of Banking and Finance 33, 662-669.

Mersland, R., Strøm, R.Ø., 2010. Microfinance mission drift? World Development 38, 28-36.

Mersland, R., Randøy, T., Strøm, R. Ø., 2011. The Impact of International Influence on Microbanks Performance: A Global Survey, International Business Review. Vol. 20, pp. 163-176.

Mitchell, K., Onvural, N.M., 1996. Economies of scale and scope at large commercial banks: Evidence from the Fourier flexible functional form. Journal of Money, Credit, and Banking 28, 178–199.

Nawaz, A., 2009. Efficiency and productivity of microfinance: Incorporating the role of subsidies. PhD Dissertation, University of Gottingen, Germany.

Paxton, J., 2007. Technical efficiency in a semi-formal financial sector: The case of Mexico. Oxford Bulletin of Economics and Statistics 69, 8305-9049.

Stiroh, K., 1999. Measuring input substitution in thrifts: Morishima, Allen-Uzawa, and cross-price elasticities. Journal of Economics and Business 51, 145-157.

Swanson, B., 2008. The role of international capital markets in microfinance. In: Sundaresan, S., (Ed.), Microfinance: Emerging Trends and Challenges. Edward Elgar, Cheltenham, UK; Northampton, USA.

Van Cayseele, P., Wuyts, C., 2007. Cost efficiency in the European securities settlement and depository industry. Journal of Banking and Finance 31, 3058-3079.

Varian, H., 1984. The nonparametric approach to production analysis. Econometrica 52, 579-597.

Appendix

Table 1. Distribution of Observations by Country and Year

| Country | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 0 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 14 |
| Argentina | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Armenia | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 5 |
| Azerbaijan | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 4 | 2 | 0 | 0 | 0 | 14 |
| Bangladesh | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| Benin | 0 | 0 | 3 | 3 | 4 | 4 | 3 | 1 | 2 | 1 | 0 | 0 | 0 | 21 |
| Bolivia | 0 | 2 | 2 | 10 | 13 | 13 | 14 | 9 | 3 | 3 | 1 | 0 | 0 | 70 |
| Bosnia Hercegovina | 0 | 0 | 1 | 2 | 6 | 8 | 6 | 4 | 2 | 1 | 0 | 0 | 0 | 30 |
| Brazil | 0 | 0 | 4 | 8 | 9 | 8 | 8 | 4 | 1 | 1 | 1 | 2 | 0 | 46 |
| Bulgaria | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| Burkina Faso | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 7 |
| Cambodia | 0 | 0 | 0 | 0 | 2 | 4 | 5 | 7 | 7 | 3 | 1 | 0 | 0 | 29 |
| Cameroun | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 9 |
| Chad | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Chile | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 |
| Colombia | 2 | 3 | 5 | 5 | 3 | 4 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 27 |
| Croatia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Dominican Republic | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 15 |
| DRC - Kinshasa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| East Timor | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Ecuador | 0 | 0 | 1 | 5 | 6 | 10 | 13 | 12 | 14 | 4 | 3 | 1 | 0 | 69 |
| Egypt | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| El Salvador | 0 | 0 | 0 | 2 | 3 | 4 | 2 | 2 | 4 | 2 | 2 | 1 | 0 | 22 |
| Ethiopia | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 5 | 6 | 6 | 0 | 0 | 0 | 23 |
| Georgia | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 4 | 0 | 0 | 0 | 0 | 11 |
| Ghana | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 5 |
| Guatemala | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 3 | 4 | 3 | 2 | 2 | 0 | 21 |
| Guinea | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Haiti | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 0 | 13 |
| Honduras | 0 | 0 | 0 | 1 | 1 | 3 | 6 | 7 | 6 | 2 | 2 | 1 | 0 | 29 |
| India | 0 | 0 | 3 | 3 | 4 | 2 | 2 | 1 | 3 | 5 | 1 | 0 | 0 | 24 |
| Jordan | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 8 |
| Kazakhstan | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 8 |
| Kenya | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 4 | 2 | 1 | 0 | 16 |
| Kosovo | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 9 |
| Kyrgyzstan | 0 | 0 | 0 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 11 |
| Madagascar | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 5 |
| Malawi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| Mali | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 10 |

| Country | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mexico | 0 | 2 | 3 | 5 | 6 | 10 | 10 | 9 | 8 | 3 | 2 | 2 | 0 | 60 |
| Moldova | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 7 |
| Mongolia | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 5 |
| Montenegro | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Morocco | 0 | 0 | 1 | 1 | 3 | 4 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 16 |
| Mozambique | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 |
| Nepal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| Nicaragua | 0 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 6 | 2 | 1 | 1 | 0 | 41 |
| Niger | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 4 |
| Nigeria | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| Paraguay | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 11 |
| Peru | 1 | 2 | 4 | 10 | 23 | 22 | 20 | 17 | 6 | 2 | 2 | 2 | 1 | 112 |
| Philippines | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 9 |
| Rep of Congo Brazz | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 |
| Romania | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Russian Federation | 0 | 1 | 2 | 2 | 1 | 2 | 4 | 7 | 9 | 5 | 0 | 0 | 0 | 33 |
| Rwanda | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 3 | 0 | 0 | 0 | 8 |
| Senegal | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 13 |
| Serbia | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| South Africa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| Tajikistan | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 1 | 0 | 0 | 0 | 9 |
| Tanzania | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 1 | 0 | 6 |
| Togo | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 3 | 0 | 0 | 0 | 8 |
| Tunisia | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Uganda | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 0 | 0 | 0 | 11 |
| Vietnam | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Zambia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 4 |
| Total | 4 | 15 | 37 | 83 | 117 | 145 | 156 | 155 | 146 | 88 | 26 | 16 | 1 | 989 |

Table 2. Summary Statistics of Key Variables

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROE | 16.6 | 2.4 | 8.7 | -7.2 | 2.8 | 1.1 | 9.7 | 8.7 | -44.5 | 12.5 | 16.7 | 15.3 | 13.2 | -1.4 |
| ROA | 7.2 | 0.1 | 0.2 | 0.7 | 2.3 | 2.8 | 2.9 | 3.3 | 2.7 | 0.7 | 4.6 | 4.8 | 8.1 | 2.4 |
| Short-term Liability | 27.6 | 25.5 | 23.6 | 22.4 | 25.2 | 26.9 | 27.4 | 29.3 | 32.6 | 32.7 | 36.1 | 38.9 | 3.9 | 28.3 |
| Debt/equity | 2.0 | 2.6 | 2.1 | 2.6 | 2.4 | 2.9 | 3.2 | 4.4 | 3.3 | 6.6 | 3.7 | 2.3 | 0.6 | 3.5 |
| Loan ratio | 117.3 | 96.3 | 89.9 | 86.8 | 87.8 | 88.7 | 88.5 | 84.0 | 82.0 | 88.2 | 74.6 | 73.3 | 67.5 | 86.3 |
| Assets (US$ Millions) | 5.6 | 6.8 | 5.2 | 6.3 | 6.9 | 6.5 | 6.0 | 5.2 | 5.3 | 4.7 | 7.0 | 8.0 | 5.4 | 5.9 |
| Legal | 2.7 | 3.6 | 3.8 | 4.1 | 4.3 | 4.2 | 4.3 | 4.3 | 4.2 | 4.3 | 4.5 | 4.9 | 7 | 4.2 |
| Market Competition | 3.7 | 3.9 | 3.9 | 4.3 | 4.5 | 4.5 | 4.5 | 4.4 | 4.3 | 4.3 | 4.5 | 4.5 | 7 | 4.4 |
| Bank Regulation | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.3 | 0 | 0.3 |
| *Type* | | | | | | | | | | | | | | |
| Bank | - | - | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 | 0.04 | - | - | 0.02 |
| NBFI | 0.25 | 0.47 | 0.24 | 0.22 | 0.22 | 0.23 | 0.26 | 0.31 | 0.34 | 0.41 | 0.35 | 0.31 | - | 0.29 |
| NGO | 0.75 | 0.47 | 0.62 | 0.66 | 0.65 | 0.60 | 0.56 | 0.50 | 0.45 | 0.34 | 0.46 | 0.63 | 1 | 0.54 |
| Coop | - | - | 0.08 | 0.07 | 0.09 | 0.11 | 0.13 | 0.16 | 0.18 | 0.19 | 0.12 | 0.06 | - | 0.13 |
| Other | - | 0.07 | 0.03 | 0.02 | 0.01 | 0.03 | 0.02 | 0.02 | 0.01 | 0.03 | 0.04 | - | - | 0.02 |
| *Loan Method* | | | | | | | | | | | | | | |
| Village bank | - | 0.13 | 0.22 | 0.16 | 0.18 | 0.14 | 0.14 | 0.16 | 0.13 | 0.16 | 0.19 | 0.13 | 1 | 0.15 |
| Solidarity Group | - | - | 0.14 | 0.09 | 0.14 | 0.15 | 0.22 | 0.31 | 0.32 | 0.38 | 0.19 | 0.19 | - | 0.22 |
| Individual loan | 1.00 | 0.87 | 0.64 | 0.75 | 0.68 | 0.71 | 0.64 | 0.54 | 0.55 | 0.46 | 0.62 | 0.69 | - | 0.62 |
| Observations | 4 | 15 | 37 | 83 | 117 | 145 | 156 | 155 | 146 | 88 | 26 | 16 | 1 | 989 |

* Short-term Liability and Loan Ratio are scaled by assets