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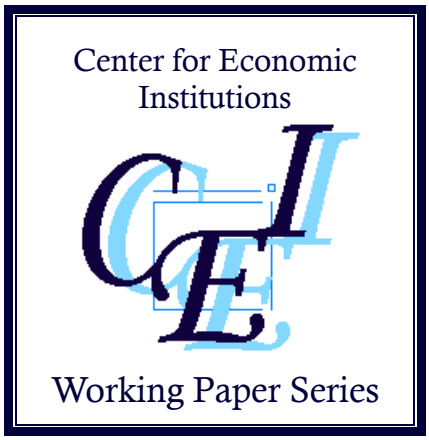

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Do Subsidies Enhance or Erode the Cost Efficiency of Microfinance? Evidence from MFI Worldwide Micro Data

Fumiharu Mieno[1] and Hisako Kai[2]

Abstract

A recent issue in the microfinance literature is whether microfinance institutions (MFIs) are financially sustainable without a subsidy as a prerequisite for competition policy or commercialization processes. Although some recent studies have proposed relevant theoretical frameworks, empirical analyses are scarce. Using financial data for MFIs across a panel of 1791 observations for 2003–2006, we estimate a cost function for the MFIs and a measure of inefficiency using the stochastic frontier cost approach, and then examine the effects of subsidies, operating age and other possible factors as determinants of efficiency. We find that subsidies are generally not an impediment to cost efficiency; instead, they are generally utilized to improve cost efficiency. We also find that the effect of a subsidy on efficiency is larger for younger MFIs, suggesting that subsidies for these institutions are effectively utilized for intensifying initial technology investment or human resource development. The findings are consistent with the arguments that stress the importance of subsidies for the initial stage of development of MFIs, and partially contradictory to the claims that the subsidies generally erode MFIs' financial sustainability.

Keywords: microfinance, financial institutions, frontier cost function approach
JEL categories: G21, O16, R51

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1. Introduction

A recent issue in the microfinance literature is whether microfinance institutions (MFIs) are financially sustainable without a subsidy as a prerequisite for competition policy or commercialization processes. Although some recent studies have proposed relevant theoretical frameworks, empirical analyses are scarce. Apart from the fundamental question regarding whether or not MFIs are sustainable without a subsidy,[3] the main issue in early studies was about the degree of dependence on the subsidy.[4]

Recently, however, the effect of a subsidy on the management of MFIs through a more complex mechanism has been found to be both positive and negative. From a negative point of view, Hudon and Traça (2008) argue that subsidies can disincentivize workers and managers in MFIs, creating a moral hazard problem. Examining the negative experiences of highly subsidized state-run banks, Armendariz de Aghion and Morduch (2005, ch. 9) point out the possibility that subsidies reduce efficiency and create a targeting error, resulting in higher operating costs.

On the other hand, the arguments supporting a subsidy for MFIs focus on set-up costs and capacity building. In the same paper, Hudon and Traça explain how subsidies enable MFIs to invest in their internal 'infrastructure' and human resources, leading to operational efficiency. Furthermore, Armendariz de Aghion and Morduch discuss 'smart subsidy' provision, stressing start-up costs and institutions' capacity building. From a similar viewpoint, Townsend and Yaron (2001) evaluate the social benefit of subsidies for MFIs using cost–benefit analysis.

Empirical studies in this area are, however, rare and controversial, as are theoretical studies. Hudon and Traça (2008) provide empirical evidence regarding the effect of subsidies on efficiency, using financial statements of 100 MFIs from 2002 to 2005, as obtained by rating agencies.[5] By observing MFIs' average operating costs, their empirical results show that moderate-sized subsidies result in lower average operating costs, suggesting efficiency improvement. On the other hand, using detailed data on numerous samples, Cull et al. (2007) provide empirical evidence showing that MFIs with greater subsidy dependence are likely to have higher average operating costs.[6]

Some empirical and theoretical studies argue the importance of the form, size and timing of subsidies. Hudon and Traça (2008) show empirically that the effects of subsidies on efficiency decline after they reach a certain level. Balkenhol (2007) also argues that the adverse effects of subsidies depend on their size and timing.

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[3] Two purpose and trade off.
[4] For example, see Yarron (1994) and Morduch (1999).
[5] Planet Rating and Microfinanze.
[6] They show that MFIs that are subsidy dependent are more likely to have smaller loans and lower financial self-sufficiency.

The analytical methodology of the existing empirical studies is relatively basic. One pioneering study that uses a formal methodology is that of Gutierrez et al. (2007), who estimate the efficiency of MFIs in Latin America using a data envelopment analysis approach, and find that nongovernmental organizations (NGOs) operate more efficiently.[7]

Compared with such previous studies, our main focus is on how subsidies improve MFIs' operations. This paper attempts to estimate the effect of subsidies on operating costs from two perspectives: i) economies of scale (scale merit), and ii) operational efficiency. Using a comprehensive dataset of MFIs' financial statements, and estimating a stochastic-frontier-approach cost function, we examine the elasticity of scale and the determinants of the efficiency of MFI operations, and attempt to capture the process by which operational costs decrease in newly established MFIs, and the conditions in which a subsidy is effective.

The rest of the paper is organized as follows. Section 2 discusses the possible mechanisms through which subsidies affect the operations of MFIs, particularly in the context of MFIs' growth processes. Section 3 discusses our data sample and provides descriptive statistics. The estimation methodology is discussed in Section 4, and the results are examined in Section 5. Section 6 concludes.

2. Cost Structure and the Effects of Subsidies

To identify how subsidies improve the efficiency of MFI operations, we need to start with the cost structure. Firstly, we need to consider the relationship between operational scale and average costs. In particular, newly established MFIs are usually in the process of expanding their operations. If their cost structure involves economies of scale, average costs will decline as they expand.

Secondly, if operational efficiency differs among the MFIs, we need to capture its basic determinants, before discussing the effect of subsidies. In particular, it is important to examine whether or not a learning process exists in newly established MFIs; i.e. if a learning process exists, a subsidy for young MFIs can be justified from a dynamic externality perspective.

The debt/equity ratio is another possible major determinant of efficiency. As shown in standard moral hazard models or prudential regulation models, highly leveraged financial institutions tend to be too risk preferring, resulting in a deviation from efficient operations. In microfinance, however, a different perspective has been discussed. Equity sometimes involves an endowment from a donor, which includes the subsidy factors (Conning, 1999). In such a case,

[7] However, they did not examine the relationship between subsidies and efficiency.

equity can have similar effects to a subsidy.

In addition to the two preliminary analyses mentioned above, we also need to examine the type of subsidy received by the MFIs. For example, what types of MFIs receive larger subsidies, e.g. young or old, and what are the major forms of assistance, e.g. subsidized loans or direct donations? Furthermore, we should examine whether these forms of assistance are consistent with theoretical findings related to cost structures, i.e. economies of scale or determinants of efficiency.

Careful evaluation of the effect of subsidies is possible only after examining cost structures and forms of assistance. Regarding i) operational scale and average costs, if economies of scale exist, they may be a major source of declining average costs. Subsidies can be evaluated from the perspective of whether they contribute to young MFIs achieving economies of scale. Regarding ii) determinants of operational efficiency, subsidies can be evaluated in the context of their direct effect, and also their interaction effects with other determinants. In particular, we will focus on the difference between younger and older MFIs.

3. Data and Descriptive Statistics

3.1. Data Source

The data for the analysis are unbalanced panel data from 866 MFIs in 85 countries from 2003 to 2006, obtained from the Microfinance Information eXchange, Inc. (MIX). This provides some information regarding individual MFIs' income statements, fundraising activities and basic profiles, whereas it does not identify the firms themselves. MIX compiles two types of data series. 'Unadjusted data' provide almost raw data from each MFI audit, partially reclassified to a common format. 'Adjusted data' are processed data adjusted for (1) the effects of inflation, (2) the variation of loan loss provision standards in each MFI, and (3) deduced the subsidy factors, calculated under MIX's criteria.

MIX classifies MFIs into two main categories: 'Socially Motivated', and 'Profit Motivated', with six subcategories: (i) 'Banks', (ii) 'Credit Unions/Cooperatives', (iii) 'NGOs', (iv) 'Nonbank Financial Intermediaries', (v) 'Rural Banks', and (vi) Others. As shown in the table in the Appendix, however, most Socially Motivated MFIs consist of subcategories (ii), (iii) and (iv), and all Profit Motivated MFIs consist of subcategories (i), (iv) and (v). Furthermore, in the latter category, the major difference in the scale of operations is between (i) Banks and the smaller (iv) Nonbank Financial Intermediaries and (v) Rural Banks. Considering the distribution of the sample, we adopt three categories for the quantitative analysis: A) Socially Motivated, B) Profit Motivated Banks (subcategory (i)), and C) Profit Motivated Nonbanks (subcategories (iv) and

(v)).[8] As summarized in Table 1, our sample consists of 571 Socially Motivated Banks, 66 Profit Motivated Banks, and 295 Profit Motivated Nonbanks.

3.2. Profitability and Subsidies

Table 2 shows the income and cost structures of the sample MFIs. According to the database, the total costs consist of financial expenses, operational costs and loan losses. Comparing the two types of data series with a few reasonable assumptions, we can decompose the 'adjustment' factors into a) the inflation adjustment for financial expenses, b) the adjustment for the loan loss calculation, c) subsidy for financial expenses, and d) subsidy for operational expenses, resulting in a clear separation of the subsidy and other factors. Row (3) of Table 2 shows the unadjusted figures for expenses, income and return on assets (ROA). Row (2) shows the adjusted figures for nonsubsidy factors, i.e. a) inflation and b) loan loss calculation. Row (1) shows the figures where the subsidies for financial expenses and operational costs are removed.

Table 2 reveals a few simple facts. While many MFIs seem to achieve positive profit under a subsidized cost structure, the actual profit on a nonsubsidized basis is negative on average. The ROA using the subsidy-deducted calculations shows a –1.0% loss on average. The low profitability is remarkable for Socially Motivated Banks (–1.4% ROA) and Profit Nonbanks (–0.6% ROA). Furthermore, around 40% of institutions suffered negative profits. Only Banks earned positive profits on average.

Table 2 also suggests that most explicit subsidies are provided in the form of subsidized fund raising, whereas direct subsidies to operational costs are not commonly used. The subsidy covers 30.4% of fundraising costs, and 7.6% of total costs.

Among the components of total costs, operational costs constitute by far the largest share at 67.4%, whereas financial costs are only 23.5%. However, the share of operational costs varies among the categories: highest in Socially Motivated, and lowest in Profit Banks. The other components account for similar shares in the three categories, such that the total costs are highest in Socially Motivated and lowest in Profit Banks. In other words, differences in total costs are accounted for mainly by the differences in operational costs.

The ratio of subsidy to financial costs is the highest in Socially Motivated at 33.7%, and relatively low in Profit Banks and Profit Nonbanks at 22.5% and 24.6%, respectively. However, because the ratio of financial costs to total costs is the highest (hence the subsidy in the form of interest compensation is largest) in Profit Banks, the ratio of subsidies to total costs is relatively high in Profit Banks compared with Socially Motivated (8.2% and 7.8%, respectively).

[8] Hereafter, we will simply use the terms Profit Banks and Profit Nonbanks.

Table 3 and Table 4 summarize the same calculations classified by age of the MFI for the Socially Motivated and Profit Nonbanks, respectively. The trends that are common to the two groups for each age category are as follows: 1) operational costs, the largest cost component, decline with firm age; 2) the subsidy ratios for both financial costs and total costs show clear declines; and 3) ROA also declines with firm age, although the trend is unclear for Socially Motivated.[9] However, while subsidized financial costs show a clear decline, there is no difference for subsidy-deducted financial costs across different firm age categories: constant for Socially Motivated and possibly increasing for Profit Nonbanks. Accordingly, the apparent improvement in ROA (subsidy deducted) is produced mainly by a decline in operational costs, not financial costs or loan loss costs.

3.3. Fundraising and Subsidies

Table 5-(1) shows the MFIs' fundraising structure classified by category and firm age, normalized by loan value. In addition, Table 5-(2) shows the components of the fundraising structure in percentage terms. The tables suggest that fundraising behavior varies by both category and firm age. For the Profit Banks and Profit Nonbanks, deposits are their major funding source. The ratios of deposits plus commercial borrowings to loans are around unity, meaning that market-based fundraising covers their lending operations. However, for Socially Motivated, the ratio of deposits is quite low, and that of deposits plus commercial borrowings covers only 47% of total funding. As a result, Socially Motivated are dependent on noncommercial borrowings or soft loans, which is the major source of subsidy. Even combining the three sources, the ratio of their total value to loan value is still below unity, suggesting that equity (endowment) is utilized for a part of the necessary funding in Socially Motivated.

The change in fundraising over their operating period (i.e. firm age) is not clear, and varies by category. Firstly, commercial borrowing declines with operating period across all categories. Secondly, Profit Nonbanks do not experience an increasing share of deposits with firm age. Thirdly, for noncommercial borrowing, no clear trend exists.

3.4. Operating Scale

Table 6 compares firm operating or production scales. As found previously, Profit Banks' operating scale is much larger than that of the other two categories, by a factor of around 10 in terms of total loans, and 5 in terms of loan size. Meanwhile, the scales of Socially Motivated and Profit Nonbanks are similar in terms of total loans, number of loans and loan size.

[9] No particular tendency, however, is found for income level.

Operating size tends to increase with firm age, particularly for Socially Motivated and Profit Nonbanks.

4. Model

To assess the relationship between cost efficiency and subsidy dependency, we first estimate the cost inefficiency of MFIs using a stochastic frontier approach, and then conduct factor analysis of the estimated cost inefficiency using panel data regression. Our empirical analysis is based on unbalanced panel data between 2003 and 2006 for 866 MFIs. We separate the sample by MFI categories and conduct empirical analyses.

4.1. Cost Functions and Economies of Scale

Firstly, we estimate a translog cost function and the elasticity of scale to examine the basic cost structure of MFIs. The translog cost function can be expressed in the following form:

$$\ln C_{it} = \alpha_0 + \alpha_1 \ln L_{it} + \sum_{j=1}^{2} \beta_j \ln p_{jit} + \frac{1}{2}\alpha_2 (\ln L_{it})^2 + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2} \beta_{jk} \ln p_{jit} \ln p_{kit} + \frac{1}{2}\sum_{j=1}^{2} \gamma_j \ln L_{it} \ln p_{jit} + \nu_{it} \quad (3.1)$$

where C_{it} is operating costs, L_{it} is the gross loan portfolio, p_{1it} is the capital price, p_{2it} is the wages of MFI employees and ν_{it} is the random disturbance. Additionally, we introduce the region dummy $REGION_i$ to capture regional effects. To capture the effect of firm age, we also introduce $Vintage_{it}$.

The elasticity of scale, ES, is calculated from the following formula.

$$ES = \alpha_1 + \alpha_2 \ln L + \frac{1}{2}\sum_{j=1}^{2} \gamma_j \ln p_j \quad (3.2)$$

As is shown in the formula, the elasticity usually varies along the production and factor price points. We primarily evaluate the elasticity at sample average values.

4.2. Stochastic Frontier Cost Function Approach

(1) Cost Function

In the second stage, we estimate the determinants of inefficiency. Firstly, we estimate a translog stochastic frontier cost function to measure cost inefficiency.[10] The formulation is as follows.

$$\ln C_{it} = \alpha_0 + \alpha_1 \ln L_{it} + \sum_{j=1}^{2} \beta_j \ln p_{jit} + \frac{1}{2}\alpha_2 (\ln L_{it})^2 + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2} \beta_{jk} \ln p_{jit} \ln p_{kit} + \frac{1}{2}\sum_{j=1}^{2} \gamma_j \ln L_{it} \ln p_{jit} + \nu_{it} + \mu_{it} \quad (3.3)$$

The formulation is the same as in (3.1.), except for the inclusion of a cost inefficiency measure, μ_{it} ($\mu_{it} > 0$).

Our analysis assumes a half-normal distribution for cost inefficiency. The analysis employs the standard (conditional mean) inefficiency approach proposed by Jondow et al. (1982) to estimate a measure of cost inefficiency.[11]

To ensure theoretical consistency of the cost function, the following conditions need to be satisfied.

1) Monotonicity
2) Homogeneity of degree one in input prices
3) Second-order conditions for cost minimization
4) Cross-price term symmetry

We estimate a restricted model by imposing conditions 2) *homogeneity of degree one in input prices* and 4) *cross-price term symmetry* on model 1.

$$\sum_{j=1}^{2} \beta_j = 1 (j = 1,2)$$
$$\sum_{j=1}^{2} \beta_{jk} = 0 (j,k = 1,2)$$
$$\beta_{jk} = \beta_{kj} (j,k = 1,2)$$

The conditions of 1) *monotonicity* and 3) *second-order conditions for cost minimization* are

[10] The translog stochastic frontier cost function analysis is generally employed without a cost share function in previous studies. Consequently, this paper follows previous studies by not including a cost share function.
[11] We estimate minus the natural log of the technical efficiency via E(u|e) as inefficiency, using Stata.

to be tested using the estimation results.

(2) Factor Analysis of Cost Inefficiency

Next, we use the panel data regression methodology to assess the relationship between cost inefficiency and subsidy dependency. Hausman test results suggest that the explanatory variables and the fixed effects are correlated, leading us to choose the fixed effect model over the random effect model.[12] We employ the least squares dummy variables (LSDV) method to estimate:

$$IE_{it} = \eta_0 + \phi_1 subsidy_{it} + \phi_2 v\text{int}\, age_{it} + \phi_3 (subsidy_{it} * v\text{int}\, age_{it}) + \phi_4 capital\ to\ asset_{it} + \phi_5 BranchIntensity_{it} + \varepsilon_{it} \quad (3.4)$$

where IE_{it} is cost inefficiency, $subsidy_{it}$ is a measure of subsidy dependence, $v\text{int}\, age_{it}$ is the MFI's age, $capital\ to\ asset_{it}$ is the capital-to-asset ratio, BranchIntensity is Branch per gross loan portfolio and ε_{it} is a random disturbance.

The measure of subsidy dependency is included to assess the effect of subsidy dependence on cost inefficiency. The interaction terms between subsidy and MFI age are included in order to examine the compound effect of subsidy dependency and MFI age on cost inefficiency. The aim of this is to analyze whether subsidies for initial investment are more effective than subsidies for later investment.

The analysis includes control variables such as MFI age, capital-to-asset ratio and branch per gross loan portfolio. We expect older MFIs to have a lower cost structure through higher information production, leading to improvements in efficiency. Thus, we can assume that inefficiency declines as MFIs increase in operating age.

We also expect MFIs with a higher capital-to-asset ratio to be efficient, because they tend to have sound finance because of their lower dependency on outside capital. Furthermore, we test whether branch installment, the largest fixed capital cost, is an impediment to realizing an optimal combination of inputs.

5. Estimation Results

5.1. Economies of Scale and Cost Savings

The estimation results of the cost function are shown in Table 7. The estimations are conducted for each sample group of Socially Motivated, Profit Banks and Nonprofit Banks, and for the

[12] See Hausman (1978).

former for the age groups. To examine the effect of operational period, we also estimate the cost function with the age variable, as shown in Table 8. The coefficients of the variables are of reasonable value and expected sign. The results confirm monotonicity of all variables for all sample groups, and also confirm concavity in all input prices, satisfying the second-order condition for cost minimization.[13] Further details regarding the restriction checks are provided in the Appendix.

The elasticity of scale parameter at the sample average is less than unity (0.84–0.91) for all categories. In particular, the elasticity parameter is extremely small for Profit Banks. The estimation results support the existence of economies of scale. Furthermore, in Socially Motivated the elasticity is smaller for the younger group (less than five years) than the older group, suggesting that newly established MFIs must compete in an environment in which economies of scale exist.

The coefficient of the square value of production α_2 is positive, meaning that the elasticity of scale for operational costs increases (the scale merit declines) as the production scale increases. The row 'Threshold Value of lnL' in Table 7 shows the threshold value of production (lnL) where the elasticity of scale equals unity, i.e. MFIs with larger production scales than the threshold value are experiencing diseconomies of scale. This row also indicates that a large number of the samples (e.g. 13.6% of the Socially Motivated sample) are in the zone of diseconomies of scale. This suggests that some MFIs are too large from an efficient-operation-scale perspective.

Our results confirm economies of scale, in particular for the young MFIs. Furthermore, as observed in Section 3, the young MFIs are usually in the expansion phase of their operations. These two facts suggest that young and growing MFIs usually enjoy declining average costs. In fact, Tables 3 and 4 in Section 3 suggest that operational costs decline with age. The estimation results, however, do not provide strong confirmation of this mechanism. Table 8 shows that the coefficients of vintage are negative in all three categories, which is consistent with the scale merit mechanism; however, the coefficient is significant only for Profit Nonbanks. The results suggest the existence of other mechanisms that increase average costs during the growth process for young MFIs. The view is consistent with the arguments of internal 'infrastructure', capacity building or start-up cost factors discussed in Hudon and Traça (2008) and Armendariz de Aghion and Morduch (2005, ch. 9).

[13] To test homogeneity of degree one in input prices and cross-price term symmetry, we estimate the model without these restrictions. In the regression results, Wald tests reject the restrictions, and some coefficients are insignificant in the nonrestricted model, indicating that restricted models provide a better fit.

5.2. The Determinants of Cost Efficiency

For the estimation of the determinants of cost efficiency, we calculate the inefficiency measure based on the cost function shown in Table 7. Table 9 shows the LSDV regression results for Socially Motivated and Profit Nonbanks (the case of Profit Banks is omitted), which are used for the factor analysis of inefficiency.

With regard to the control variables, the capital-to-asset ratio is positive and significant for Profit Nonbanks, which suggests that the larger MFIs that are dependent on equity are less efficient. The result is controversial, as it opposes the moral hazard view on leveraged financial institutions. The intensity of the branch is found to be positive in both the Socially Motivated and Profit Nonbanks. Branch building is a fixed cost, and appears to be an impediment to realizing an efficient combination of inputs. Interestingly, for Socially Motivated, the coefficient is not significant for the young MFIs that may experience a rapid expansion process.

The effect of age is one of our major focuses. In the Profit Nonbanks, sample age is not significant, whereas it is significant and positive for Socially Motivated. Oddly, the estimation results show that the effect is significant only for the older MFIs and not for the younger MFIs, suggesting that a kind of 'learning process' for efficiency improvement is not apparent in young MFIs, and erosion of efficiency occurs in older MFIs.

5.3. Subsidies and Cost Efficiency

Regarding the effect of subsidies, the results show that the subsidy variable is significantly negative in both categories, indicating that subsidies improve MFIs' efficiency. Our results support the importance of the role of subsidies in capacity building (Cull et al. (2007)), and are controversial in that they oppose research claiming that subsidies are a waste of resources (Hudon and Traça (2008)).

Another interesting finding is the difference in the subsidy effect by age. Firstly, dividing the sample by age into the young (less than five years) and the old (six years and more), the subsidy coefficient is significant only in the former. This suggests that the positive effect on efficiency operates solely for the young MFIs, which are in the process of rapid operational expansion and capacity building.

Secondly, the coefficients of the interaction between subsidies and age are significant and positive for Socially Motivated. This suggests that the positive effect of subsidies on efficiency weakens as MFIs get older. Dividing the sample by vintage, the coefficient of the interaction term in the younger MFIs becomes insignificant. This finding indicates that MFIs enjoy the positive effect of subsidies in their early years; however, this effect declines later.

6. Discussion and Conclusions

Our paper provides evidence of the nature of the effect of subsidies on MFIs' cost structure. We summarize the findings as follows. Firstly, in terms of efficiency, average costs are apparently lower in the MFIs that receive larger subsidies mainly through interest compensation. The subsidies do not involve a waste of resources; rather, the surplus, which is in turn used for investment in fixed or sunk cost factors, results in an improvement in the efficiency of operations.

Secondly, the cost structure of MFIs displays economies of scale, particularly for the young MFIs. In addition, the operating scale tends to expand along with operational experience, particularly in the early period of operations. Hence, in the expansion of the scale of operations, MFIs must enjoy declining average costs, at least logically. However, we could not find any evidence of declining average costs with respect to age in the empirical analysis. Likewise, the 'learning effect' in operations was not supported by the efficiency factor analysis. The conclusion in this respect is that age (operational experience) appears to be related to declining costs, but this could not be confirmed. One possible interpretation is that there are other factors involved in the process of operational expansion that increase costs, which cancels out the cost-decreasing effects.

Thirdly, and probably related to the second finding, the effect of subsidies on cost reductions is strong if MFIs receive a subsidy in their early years. The subsidy appears to weaken the cost pressures that young MFIs face, and to help them achieve cost reductions by expanding their scale.

If we assume that this upward pressure on costs stems from additional expenditure for capacity building or other start-up costs faced by young MFIs, our findings are consistent with the view that subsidies have positive effects, discussed in Hudon and Traça (2008), Armendariz de Aghion and Morduch (2005, ch. 9) and Cull et al. (2007).

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Appendix: Restriction Checks

1. Monotonicity Check

$\frac{\partial C}{\partial L} = \frac{C}{L} * \frac{\partial LnC}{\partial LnL} > 0$ needs to be satisfied for monotonicity.

As $\frac{C}{L} > 0$, $\frac{\partial LnC}{\partial LnL} > 0$ should hold.

I test monotonicity of output at the sample mean as follows.

$$\frac{\partial LnC}{\partial LnL} = 0.887801 > 0(SocialMotivated)$$
$$\frac{\partial LnC}{\partial LnL} = 0.831117 > 0(\text{Pr}ofit - Bank)$$
$$\frac{\partial LnC}{\partial LnL} = 0.885233 > 0(\text{Pr}ofit - Nonbank)$$

Consequently, monotonicity of output is confirmed for Socially Motivated and Profit MFIs.

Similarly, I test monotonicity of inputs at the sample mean as follows.

$$\frac{\partial LnC}{\partial LnP_1} = 0.782659 > 0(SocialMotivated)$$
$$\frac{\partial LnC}{\partial LnP_1} = 0.679788 > 0(\text{Pr}ofit - Bank)$$
$$\frac{\partial LnC}{\partial LnP_1} = 0.730779 > 0(\text{Pr}ofit - Nonbank)$$
$$\frac{\partial LnC}{\partial LnP_2} = 0.217341 > 0(SocialMotivated)$$
$$\frac{\partial LnC}{\partial LnP_2} = 0.320212 > 0(\text{Pr}ofit - Bank)$$
$$\frac{\partial LnC}{\partial LnP_2} = 0.269221 > 0(\text{Pr}ofit - Nonbank)$$

Consequently, monotonicity of all inputs is confirmed for Socially Motivated and Profit MFIs.

2. Second-Order Condition Checks

To satisfy the second-order conditions, the Hessian matrix should be negative semidefinite. As homogeneity of degree one in input prices is assumed here, each diagonal element of the Hessian

matrix must be nonpositive. I calculate the diagonal elements of the Hessian matrix at the sample mean as follows.

$$\frac{\partial^2 C}{\partial^2 P_1^2} = \text{-0.13656} < 0(SocialMotivated)$$

$$\frac{\partial^2 C}{\partial^2 P_1^2} = 0.012750 > 0(\text{Pr}\,ofit - Bank)$$

$$\frac{\partial^2 C}{\partial^2 P_1^2} = \text{-0.05086} < 0(\text{Pr}\,ofit - Nonbank)$$

$$\frac{\partial^2 C}{\partial^2 P_2^2} = \text{-0.15956} < 0(SocialMotivated)$$

$$\frac{\partial^2 C}{\partial^2 P_2^2} = 0.006489 > 0(\text{Pr}\,ofit - Bank)$$

$$\frac{\partial^2 C}{\partial^2 P_2^2} = \text{-0.06620} < 0(Social - Nonbank)$$

Thus, as each diagonal element of the Hessian matrix is nonpositive, the concavity of all input prices for Socially Motivated and Profit Nonbanks is confirmed.

Appendix Table, Distribution of Source Sample

		Average Loan Size (Mil. USD)	Average No of Employ	Average No of Office	No. of Sample MFIs					
					Total	Asia	East and Central America	Latin American	Meddle East and North Africa	Sub Sahara Africa
Socially Motivated	**Total**	**17.1**	**215.7**	**29.0**	**571**	**134**	**107**	**212**	**37**	**81**
	Bank	1,261.0	7,155	665	1	1	0	0	0	0
	Credit Union / Cooperative	32.0	138	26	104	12	24	43	0	25
	Organization (NGO)	8.6	239	31	382	108	43	156	29	46
	Non-Bank Financial Intermediary	22.5	125	15	83	13	40	13	7	10
	Rural Bank	-	-	-	-	0	0	0	0	0
	Other	13.8	198	14	1	0	0	0	1	0
Profit Motivated	**Total**	**68.8**	**463.6**	**55.5**	**295**	**106**	**41**	**68**	**0**	**80**
	Bank	257.5	1,362	180	66	17	23	15	0	11
	Credit Union / Cooperative	-	-	-	-	0	0	0	0	0
	Organization (NGO)	-	-	-	-	0	0	0	0	0
	Non-Bank Financial Intermediary	20.0	252	23	144	29	18	53	0	44
	Rural Bank	5.0	80	8	85	60	0	0	0	25
	Other	-	-	-	-	0	0	0	0	0
	Ground Total	**34.7**	**298.3**	**37.8**	**866**	**240**	**148**	**280**	**37**	**161**

Table 1. Distribution of Sample

		Average Loan Size (Mil. USD)	Average No of Employ	Average No of Office	No. of Sample MFIs
Social Motivated	Credit Union / Cooperative	32.0	138	26	104
	Non Governmental Organization (NGO)	8.6	239	31	382
	Non-Bank Financial Intermediary	22.5	125	15	83
	Total	17.1	215.7	29.0	571
Profit Bank	Total	257.5	1,362	180	66
Profit Non Bank	Rural Bank	5.0	80	8	85
	Non-Bank Financial Intermediary	20.0	252	23	144
	Total	68.8	463.6	55.5	295
	Ground Total	34.7	298.3	37.8	866

Table 2 Cost-Profit Structure and Subsidy
(1) All Samples

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.010	0.279	0.289	0.068	0.195	0.026
(2)		Subsidized, Adjusted*	0.012	0.279	0.267	0.048	0.194	0.026
(3)		Subsidized, Unadjusted	0.021	0.279	0.258	0.047	0.194	0.017
(4)	(1) - (2)	Subsidy			0.022	0.021	0.001	
(5)	(4) / (1)	Subsidy Ratio			7.6%	30.4%	0.6%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 2 Cost-Profit Structure and Subsidy
(2) Social Motivated

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.014	0.292	0.306	0.068	0.213	0.025
(2)		Subsidized, Adjusted*	0.010	0.292	0.282	0.045	0.212	0.025
(3)		Subsidized, Unadjusted	0.018	0.292	0.274	0.045	0.212	0.017
(4)	(1) - (2)	Subsidy			0.024	0.023	0.001	
(5)	(4) / (1)	Subsidy Ratio			7.8%	33.7%	0.5%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 2 Cost-Profit Structure and Subsidy
(3) Profit Bank

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	0.006	0.240	0.234	0.079	0.130	0.025
(2)		Subsidized, Adjusted*	0.025	0.240	0.214	0.061	0.128	0.025
(3)		Subsidized, Unadjusted	0.034	0.240	0.206	0.061	0.128	0.017
(4)	(1) - (2)	Subsidy			0.019	0.018	0.002	
(5)	(4) / (1)	Subsidy Ratio			8.2%	22.5%	1.2%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 2 Cost-Profit Structure and Subsidy
(4) Profit Non Bank

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.004	0.256	0.261	0.066	0.168	0.027
(2)		Subsidized, Adjusted*	0.013	0.256	0.244	0.050	0.167	0.027
(3)		Subsidized, Unadjusted	0.023	0.256	0.233	0.049	0.167	0.017
(4)	(1) - (2)	Subsidy			0.017	0.016	0.001	
(5)	(4) / (1)	Subsidy Ratio			6.5%	24.6%	0.5%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 3 Cost-Profit Structure and Subsidy, Social Motivated, by Vintage Group

(1) 0 - 5 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.073	0.291	0.364	0.068	0.275	0.021
(2)		Subsidized, Adjusted*	-0.043	0.291	0.334	0.039	0.274	0.021
(3)		Subsidized, Unadjusted	-0.039	0.291	0.330	0.039	0.274	0.017
(4)	(1) - (2)	Subsidy			0.030	0.029	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			8.3%	42.8%	0.4%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

(2) 6 - 10 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	0.003	0.301	0.298	0.067	0.206	0.025
(2)		Subsidized, Adjusted*	0.028	0.301	0.273	0.044	0.205	0.025
(3)		Subsidized, Unadjusted	0.035	0.301	0.266	0.044	0.205	0.017
(4)	(1) - (2)	Subsidy			0.025	0.023	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			8.2%	34.5%	0.7%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

(3) 11 - 20 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.002	0.289	0.291	0.069	0.197	0.025
(2)		Subsidized, Adjusted*	0.020	0.289	0.270	0.049	0.196	0.025
(3)		Subsidized, Unadjusted	0.028	0.289	0.261	0.048	0.196	0.017
(4)	(1) - (2)	Subsidy			0.022	0.021	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			7.4%	30.0%	0.4%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 4 Cost-Profit Structure and Subsidy, Profit Non Bank, by Vintage Group

(1) 0 - 5 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.033	0.278	0.311	0.066	0.220	0.026
(2)		Subsidized, Adjusted*	-0.008	0.278	0.286	0.042	0.219	0.026
(3)		Subsidized, Unadjusted	0.000	0.278	0.278	0.041	0.219	0.017
(4)	(1) - (2)	Subsidy			0.025	0.024	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			8.0%	36.9%	0.3%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

(2) 6 - 10 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	-0.005	0.237	0.242	0.064	0.153	0.026
(2)		Subsidized, Adjusted*	0.016	0.237	0.221	0.043	0.152	0.026
(3)		Subsidized, Unadjusted	0.025	0.237	0.213	0.043	0.152	0.017
(4)	(1) - (2)	Subsidy			0.021	0.020	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			8.6%	31.9%	0.4%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

(3) 11 - 20 years vintage

			ROA	Income	Total Expense			
						Financial Expense	Operating Expense	Impairment Losses on Loans
(1)		Subsidy deducted	0.030	0.273	0.243	0.075	0.143	0.025
(2)		Subsidized, Adjusted*	0.040	0.273	0.233	0.066	0.142	0.025
(3)		Subsidized, Unadjusted	0.049	0.273	0.224	0.064	0.142	0.017
(4)	(1) - (2)	Subsidy			0.010	0.009	0.001	
(5)	(4) / (1)	Subsidy Cost Ratio			4.1%	12.4%	0.5%	

Note: * Adjusted for the inflation and the accounting criteria in loan loss calculation

Table 5 Structure of the Fundraising

(1) Fund Raising normalized by Total Loan

		Debt					Equity	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Deposit	Commercial Borrowing	Sub Total 1 ((1)+(2))	Non-Commercial Borrowing	Sub Total 2 ((3)+(4))		Total ((5)+(6))
All	Bank	0.708	0.285	0.993	0.229	1.222	0.365	1.586
	Profit	0.683	0.348	1.031	0.320	1.351	0.549	1.901
	Nonprofit	0.149	0.321	0.470	0.337	0.807	0.582	1.389
All	0 - 5 Years	0.356	0.277	0.634	0.272	0.905	0.392	1.298
	5-10 Years	0.191	0.323	0.514	0.242	0.757	0.396	1.153
	10-20 Years	0.325	0.372	0.698	0.261	0.959	0.473	1.432
Profit Bank	0 - 5 Years	0.452	0.353	0.806	0.199	1.005	0.316	1.321
	5-10 Years	0.676	0.341	1.016	0.156	1.172	0.187	1.359
	10-20 Years	0.855	0.225	1.080	0.154	1.234	0.298	1.532
Profit Non Bank	0 - 5 Years	0.750	0.295	1.045	0.190	1.235	0.396	1.631
	5-10 Years	0.342	0.375	0.717	0.269	0.986	0.276	1.262
	10-20 Years	0.547	0.478	1.025	0.173	1.198	0.306	1.504
Sociall Motivated	0 - 5 Years	0.088	0.251	0.339	0.337	0.676	0.405	1.081
	5-10 Years	0.094	0.306	0.400	0.243	0.643	0.455	1.098
	10-20 Years	0.192	0.363	0.555	0.300	0.855	0.543	1.398

(2) Component of Fundraising (percentage share)

		Deposit	Commercial Borrowing	Non-Commercial Borrowing	Equity
All	Bank	44.6%	17.9%	14.4%	23.0%
	Profit	35.9%	18.3%	16.8%	28.9%
	Nonprofit	10.7%	23.1%	24.2%	41.9%
All	0 - 5 Years	27.5%	21.4%	20.9%	30.2%
	5-10 Years	16.6%	28.0%	21.0%	34.4%
	10-20 Years	22.7%	26.0%	18.2%	33.0%
Profit Bank	0 - 5 Years	34.2%	26.7%	15.1%	23.9%
	5-10 Years	49.7%	25.1%	11.5%	13.8%
	10-20 Years	55.8%	14.7%	10.1%	19.4%
Profit Non Bank	0 - 5 Years	46.0%	18.1%	11.6%	24.3%
	5-10 Years	27.1%	29.7%	21.3%	21.9%
	10-20 Years	36.4%	31.8%	11.5%	20.3%
Socially Motivated	0 - 5 Years	8.1%	23.2%	31.2%	37.4%
	5-10 Years	8.6%	27.8%	22.2%	41.4%
	10-20 Years	13.7%	26.0%	21.4%	38.8%

Table 6 Average Operation Scale

		Loan	Loan /TA	No of Loans	No of Loans /TA	Average Loan Size	Total Asset (T.A)	No. of Sample
		TH. USD	%		%	USD	TH. USD	
All		26,136	74.3%	60,423	0.909%	1,032	38,167	1931
	Bank	148,438	68.6%	188,320	0.121%	3,249	237,156	180
	Profit	14,583	67.5%	43,404	0.298%	682	19,810	454
	Nonprofit	13,207	77.5%	49,092	1.227%	855	16,976	1297
	0 - 5 Years	17,817	69.8%	19,776	2.869%	1,619	26,958	448
	5-10 Years	19,924	77.7%	36,675	0.341%	887	26,485	703
	10-20 Years	28,231	75.4%	69,033	0.318%	824	41,015	582
Profit Bank	0 - 5 Years	133,700	62.6%	31,556	0.116%	8,090	205,452	46
	5-10 Years	106,185	72.4%	81,907	0.099%	1,995	147,574	52
	10-20 Years	116,874	69.7%	127,152	0.131%	1,406	192,736	65
Profit Non Bank	0 - 5 Years	5,342	62.0%	21,762	0.333%	605	8,388	143
	5-10 Years	15,693	70.8%	53,276	0.350%	598	21,008	121
	10-20 Years	28,622	74.5%	75,553	0.293%	849	35,804	111
Social Motivated	0 - 5 Years	4,123	75.3%	16,705	4.695%	1,058	5,509	259
	5-10 Years	12,426	79.7%	28,598	0.362%	849	15,855	530
	10-20 Years	13,933	76.5%	58,134	0.354%	726	18,149	406

Table7

Empirical Results for Trans-Log Cost Function

	Social Motivated						Profit Non Bank		Profit Bank	
	total		Less than 5 years		6 to 25 years					
	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value
α_1	0.6576	0.000	0.4886	0.000	0.6982	0.000	0.5278	0.000	0.6485	0.000
β_1	0.6848	0.000	0.4921	0.000	0.7229	0.000	0.8113	0.000	1.1466	0.000
α_2	0.0589	0.000	0.0774	0.000	0.0551	0.000	0.0798	0.000	0.0568	0.000
β_5	-0.0843	0.000	-0.0258	0.412	-0.0971	0.000	-0.1704	0.000	-0.2246	0.000
α_3	0.0563	0.000	0.0519	0.000	0.0582	0.000	0.0776	0.000	0.0687	0.000
γ_t	-0.0070	0.882	-0.1075	0.274	0.0243	0.648	-0.0142	0.883	-0.0002	0.999
γ_{t2}	0.0015	0.932	0.0417	0.260	-0.0116	0.552	0.0028	0.938	0.0142	0.733
Region Dummy 1	-0.2217	0.000	-0.2761	0.000	-0.1865	0.000	-0.3647	0.000	0.1378	0.074
Region Dummy 2	-0.1610	0.000	-0.2441	0.000	-0.1314	0.000	-0.1164	0.021	0.1782	0.023
Region Dummy 3	0.1445	0.000	0.0589	0.366	0.1822	0.000	0.3491	0.254		
Region Dummy 4	-0.2264	0.000	-0.2709	0.000	-0.2000	0.000	-0.1131	0.035	0.3131	0.000
Constant	1.5592	0.000	2.0360	0.000	1.4066	0.000	2.4391	0.000	2.6179	0.000
$\sigma_v^2 + \sigma_\mu^2$	0.2145		0.1832		0.2253		0.2212		0.2711	
σ_μ / σ_v	2.6125		2.2144		2.8906		2.0838		2.4747	
Log likelihood	-252.418		-42.435		-202.510		-92.884		-85.569	
Number of Obs	1202		252		950		336		253	
Elastesity of Scale										
at sample average	0.8846		0.8390		0.8945		0.8396		0.9076	
Threshold Value of lnL*	9.6589						10.2993			
No. of Sample in the zone of Ineconomies of Scale	164						55			
- % to Total No.	13.6%						16.4%			

Note: Region Dummy 1: Eastern Europe and Central Asia, 2: Latin America, 3: Middle East and North Africa, 4: Sub- Sahara Africa. Benchmarked by Asia

* The Threshold Value of lnL; the elastesity of scale for operational cost is more (less) than unity if the lnL is larger (smaller) than the threshold.

Table 8

Empirical Results for translog Cost Function with Vintage Factor

	Social Motivated						Profit Non Bank		Profit Bank	
	total		Less than 5 years		6 to 25 years					
	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value	coefficienct	P-value
α_1	0.6605	0.000	0.4807	0.000	0.7023	0.000	0.6298	0.000	0.6801	0.000
β_1	0.6868	0.000	0.4726	0.000	0.7211	0.000	0.8395	0.000	1.0825	0.000
α_2	0.0577	0.000	0.0780	0.000	0.0535	0.000	0.0734	0.000	0.0568	0.000
β_5	-0.0839	0.000	-0.0193	0.545	-0.0950	0.000	-0.1875	0.000	-0.2194	0.000
α_3	0.0555	0.000	0.0509	0.000	0.0569	0.000	0.0826	0.000	0.0734	0.000
vintage	-0.0003	0.968	-0.0379	0.489	0.0042	0.722	-0.0589	0.000	-0.0099	0.462
vintage ^ 2	0.0003	0.594	0.0082	0.639	0.0000	0.978	0.0045	0.000	0.0013	0.194
Region Dummy 1	-0.2177	0.000	-0.2805	0.000	-0.1791	0.000	-0.4337	0.000	0.1653	0.055
Region Dummy 2	-0.1742	0.000	-0.2411	0.000	-0.1454	0.000	-0.1151	0.013	0.1706	0.031
Region Dummy 3	0.1503	0.000	0.0571	0.385	0.1924	0.000	0.4330	0.142		
Region Dummy 4	-0.2267	0.000	-0.2723	0.000	-0.2008	0.000	-0.1679	0.001	0.3126	0.000
Constant	1.5364	0.000	1.9873	0.000	1.3698	0.000	2.2188	0.000	2.3519	0.000
$\sigma_v^2 + \sigma_\mu^2$	0.2131		0.1843		0.2234		0.2040		0.2719	
σ_μ / σ_v	2.5889		2.2389		2.8455		2.0554		2.6265	
Log likelihood	-251.047		-42.499		-201.580		-80.629		-80.936	
Number of Obs	1202		252		950		336		248	

Note: Region Dummy 1: Eastern Europe and Central Asia, 2: Latin America, 3: Middle East and North Africa, 4: Sub- Sahara Africa. Benchmarked by Asia

Table 9, Least Square Dummy Variable (LSDV) Regression Results

Dependent Variable: inefficiency

	Social Motivated							
	Total				Less than 5 years			
	coefficient	P-value	coefficient	P-value	coefficient	P-value	coefficient	P-value
Subsidy	-1.5348	0.004	0.2093	0.446	-2.3938	0.040	-1.0760	0.062
Vintage	0.0071	0.070	0.0100	0.010	0.0014	0.927	0.0112	0.388
[Subsidy] * [Vintage]	0.1935	0.000			0.3755	0.191		
Capital to Asset	0.0193	0.578	0.0238	0.497	-0.0449	0.627	-0.0270	0.768
Office / loan	4,789	0.000	4,264	0.000	2,872	0.131	2,630	0.166
Constant	0.1996	0.004	0.1721	0.014	0.8631	0.000	0.8062	0.000
Number of obs	1200		1200		252		252	
Adj R-Squared	0.7876		0.7832		0.770		0.768	
Prob > F	0		0.000		0.000		0.000	
Hausman	0		0.000		0.000		0.000	

	Social Motivated				Profit Non Bank			
	6 to 25 years							
	coefficient	P-value	coefficient	P-value	coefficient	P-value	coefficient	P-value
Subsidy	-1.0277	0.212	0.6392	0.063	-1.4580	0.072	-0.6752	0.168
Vintage	0.0155	0.002	0.0178	0.000	-0.0096	0.203	-0.0065	0.361
[Subsidy] * [Vintage]	0.1530	0.026			0.1700	0.223		
Capital to Asset	0.0519	0.236	0.0525	0.232	0.2892	0.001	0.2615	0.002
Office / loan	7,587	0.000	7,363	0.000	5,981	0.000	5,968	0.000
Constant	0.0928	0.252	0.0693	0.390	0.1004	0.250	0.1052	0.228
Number of obs	948		948		336		336	
Adj R-Squared	0.7858		0.7842		0.7644		0.7638	
Prob > F	0.000		0.000		0.000		0.000	
Hausman	0.000		0.000		0.000		0.000	