When Institutional Quality Can Do Harm

The Impact of Institutions and Regulation on the Performance of Microfinance Organisations

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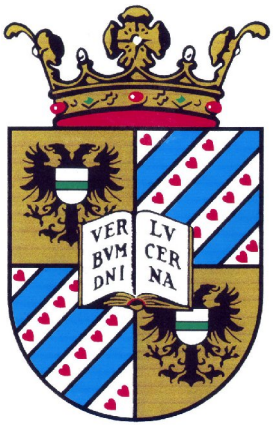

Abstract

This paper uses a stochastic frontier analysis to examine the influence of institutions and financial regulation on the performance of Micro Finance Institutions (MFIs). The sample size covers more than 1200 observations, with data coming from MFIs located in 59 different countries for the years 1996-2006. The estimation results indicate that MFIs perform better in countries where institutional quality is low, but that well-developed institutions benefit MFI performance on condition that the MFI is regulated.

Keywords: Micro Finance Institutions (MFIs), Institutional Quality, Regulation, Stochastic Frontier Analysis, Inefficiency

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Table of contents

1. Introduction

Usually, poor people have no access to loans from the banking system because they cannot provide acceptable collateral or because the costs of lending to the poor are too high to make lending profitable. However, since the 1970s the poor gained access to small loans offered by microfinance organizations. Microfinance is a relatively new strategy of banking for the poor, which especially during the past ten years has been introduced in many developing countries. The main idea behind microfinance is that poor people, who have no collateral, should have access to some sort of financial services. These services are being offered by microfinance institutions (MFIs), which generally receive financial support from western donors, NGOs or commercial banks against below market interest rates. MFIs lend this money in small loans to domestic small and poor agents. Although these financial institutions provide a wide range of financial services the main focus is on providing credit to the poor.

Because providing microfinance is a costly business the financial sustainability of MFIs has been discussed extensively in the empirical literature. Besides transaction, information and operational costs, the institutional settings of a country are another important determinant of the performance of financial institutions. Moreover, extensive amounts of literature discuss the necessity of well-developed institutions and financial regulation for the efficient operations of financial systems.[1] Evidence suggests that a sound regulatory and political framework will aid the performance of financial institutions and drive economic growth.

However, more recent discussion and debate suggest that it may not be self-evident that institutional quality leads to better performance of MFIs.

MFIs have been developing and growing in nations with weak institutional settings. In fact, MFIs can prosper in these weak environments because their operations do not have to rely on formal institutions.

Obviously, there exists a contradiction in the literature, where one stand presents the importance of well-developed institutions and financial regulation for an efficient operation of MFIs, whereas the other shows the damage they may do on MFI performance. This second recently developed and perhaps controversial view is unfortunately not yet widely supported

[1] *Institutions* include the following six institutional indicators identified by Kaufmann et al. (2006): Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption: see section 4.3 for detailed description of these indicators.
(Financial) regulation refers to the state to which financial institutions are being controlled or governed by either a government or non-government organization: see section 2.1.3 and Appendix 1 for a more detailed description of regulation.
Institutional quality refers to the institutional and regulatory framework to which (financial) organisations are subjected.

by empirical evidence. Hence, this study contributes to the existing theoretical literature of the relation between institutions, regulation and MFI performance by underpinning it with empirical evidence.

In this paper stochastic frontier analysis is used to estimate the impact of institutional quality on a sample of 244 microfinance institutions in 59 different countries.

The results show a negative correlation between institutions and MFI performance and regulation and MFI performance. Also, they indicate that well-developed institutions benefit MFI performance if the MFI is regulated.

This paper continues as follows: Section 2 first clarifies the relation between institutional quality and economic growth. Next, it discusses the contrasting existing literature of the impact of institutions and regulation on the efficiency of financial institutions and in particular MFIs. Section 3 clarifies the research questions that result from the literature review. Section 4 comprises the methodology used. Several efficiency measures are proposed and the stochastic frontier analysis is explained. In the same section the methodology is applied to estimate a stochastic cost regression for MFIs. Data sources are provided in the following section. Results and interpretation of the results are provided in section 6, whereas section 7 discusses and concludes on these results. The last section recommends potential future research.

2. Literature Review

2.1 Institutional Quality and Performance of Financial Institutions

2.1.1 Institutional Quality and the Process of Economic Growth

Since this study measures the impact of institutional quality on economic performance, which is explained by the efficient use of technology, this section clarifies the relationship between institutional quality, economic performance and technology.

Institutions are structures and mechanisms of social order and cooperation governing the behaviour of a set of individuals. They are identified with a social purpose and permanence, transcending human lives and intentions, and with the making and enforcing of rules governing cooperative human behaviour (North, 1990).

The importance of institutional quality has long been a topic for discussion and debate in much empirical literature. Most of this literature has focussed on identifying an association between institutional efficiency and economic performance and argues that institutions are major determinants of welfare levels. The evidence argues that more efficient government institutions will accomplish long-run economic growth.

As North (1990) theorizes, there is little doubt that efficient working institutions are very important in terms of economic performance. In fact, they might be one of the most important underlying determinants of economic growth. Landes (1998) explains the institutional approach to growth as one where income and growth across countries are a function of institutions. According to Solow's growth accounting model there are two determinants of growth, where total output or GDP of a country depends on its endowment of input factors (physical and human capital) and the total productivity of those input factors (the residual). The total factor productivity (TFP) captures everything not accounted for by changes in input factors, such as technological progress. Consequently, a low TFP (caused by poorly developed institutions) can hinder economic development due to inefficient use of technology.[2] Moreover, the institutional environment partly determines the appropriate set of technologies in a country and the degree to which the existing technology is efficiently used by firms (Olson, 1996).

[2] See Appendix 1 for definition of technology and more terminology

According to Olson (1996) the key elements of economic development are policies and institutions. Industrialized countries seem to have achieved most of their potential while developing countries have not, notwithstanding the presence of their factor endowments or technologies. The problem is that developing countries do not have a well-developed structure of incentives to bring forth productive activities. He explains differences in wealth among nations by their differences in institutional quality and economic policy and proofs that economic performance is mostly determined by the structure of incentives. Weak institutional settings of a country increase the incentives to invest in non-productive activities, such as monopoly power and rent seeking, which can explain the inefficient use of technologies. For example, if rent seeking is regulated, the incentive for this activity decreases and there will be a more efficient allocation of resources (Bennedson et al., 2005).

Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction and define and limit the set of choices of individuals. Such constraints may be informal (social norms, conventions, moral codes) or formal (consciously designed or articulated) (North, 1990). This rules-of-the-game view is also presented by Hurwics (1996). In his approach he specifies a 'choice set' and an 'outcome function' together as a 'mechanism' or 'game form', that specifies which actions players choose and which physical outcome corresponds to the profile of the players' choices. An institution has to be designed to implement a social goal or outcome (such as efficiency) that is compatible with the incentives of the players for a certain class of the environment (technology or resource endowments) (Hurwics, 1996). In case of incompatibility between the two, there will be inefficient use of technology.

2.1.2 Institutional Quality and Financial Development

The advantages of institutional quality

With respect to the importance of institutional quality for an efficient operation of the financial system (banks, insurance companies, MFIs, credit unions etc.) several authors highlight the relationship between institutions, financial development and economic growth. Institutions and finance are separately emerging as key fundamental determinants of economic growth in the recent literature. More specifically, the exploration of what determines financial development has received growing attention. Especially, research on the effects of legal and political environment on the functioning of financial markets has been considered.

La Porta et al. (1997, 1998) argue that the origins of the legal code substantially influence the treatment of shareholders, creditors and the efficiency of contract enforcement. They document that a lower degree of private property right protection corresponds to relatively inefficient contract enforcement, higher corruption and poorly developed institutions. This type of reasoning is consistent with the *law and finance theory* of financial growth. The theory asserts that political differences shaped the major legal traditions that spread around the world through conquest and colonization. Hence, the international differences of financial institutions can be traced back to the influences of the legal traditions (Beck et al. 2001).

The *political and finance view* stresses that political factors have a greater influence on financial institutions than legal factors. This theory emphasizes that once a group gains power, it will shape politics and institutions to its own advantage. Differences in state power combined with interests of the elite determine financial development.

Rajan and Zingales (2003) show that there have been important cases where changes in interest group power alter the political landscape and hence national approaches to financial development. Haber (2006) also stresses the importance of the political economy and its effect on financial development. He argues that financial development is an outcome of specific laws and regulation, which are a result of politics and political institutions. In particular, political institutions that created institutionalized competition among political entities played a significant role in determining size and structures of bank systems.

Other studies assess the relationship between trade policy and financial development.

For example, Stulz and Williamson (2003) propose culture as an important determinant of financial development, although its impact may be tempered by the degree of openness of a

country. Chinn and Ito (2005) focus on the effect of financial openness on financial development and find a positive correlation between the two.

Finally, Demetriades and Law (2004) find evidence that financial development has greater effects on growth when the financial system is embedded within a sound institutional framework and that this is especially true for developing countries.

Obviously, literature that emphasizes the necessity of well-developed institutions for financial development is widely available. Still, there is available literature that takes another attitude towards this matter and discusses the drawback of the impact of institutional quality on financial performance.

The drawback of institutional quality

Rules and restrictions affect the efficiency of financial organisations by influencing its organizational structure. The organisations often try to circumvent regulations, which would suggest that substantial gains in efficiency and profitability might be achieved by relaxing such regulations (Berger et al., 1993). Berger is not the only one who doubts the need of rules for financial organisations. Claessens and Klingebiel (2000) suggest the benefits of little restrictions for financials activities by showing that fewer regulatory restrictions permit the exploitation of economies of scale and scope. Moreover, they reason that broader activities may enable banks to diversify income streams and create more stable banks. Barth et al. (2004) estimate the relationship between specific regulatory and supervisory practices and bank development. They find that corrective action power, restrictions on foreign loans and government ownership of a bank are all negative associated with bank development. Besides, in earlier work (2001) they show that greater regulatory restrictions on bank activities are associated with a higher probability of suffering a major banking crisis and lower banking-sector efficiency.

More relevant for this study is the impact that institutional quality may have on MFI performance, which also seems to be ambiguous.

Proponents of the drawback of institutional quality argue that MFIs are primarily established in developing countries with weak institutional settings, where they have been growing and performing well. Micro credit can help alleviating poverty and increase domestic credit demand despite weak formal and legal institutions. In fact, MFIs can prosper in those weak environments because their operations do not have to rely on such formal institutions.

For example, MFIs offer functional substitutes for legal forms of creditor protection, such as peer lending instead of enforcement of collateral. This is only possible without relying heavily

on government restrictions and support (Barr, 2004; Vogel, 1998). Since microfinance organisations have different principles than other financial institutions (microfinance is based on low-income, self-employed people with no or inadequate collateral, rather than on the conventional client base), it is not evident that regulatory quality is generally effective for the operations of MFIs.

Schreiner and Morduch (2001) compare the performance of MFIs in the U.S. with that of MFIs in the homes of the best-established microfinance banks (Bolivia, Bangladesh and Indonesia). They show that the institutional environment in the U.S. makes microfinance much more difficult. In contrast to developed countries, such as the U.S., developing countries tend to have large, dynamic, informal systems, where regulatory quality and taxes are largely absent, which increases the potential for microfinance performance. In fact, microfinance has not taken hold well in large and middle-income counties, where government restrictions might be enforced and where public development banks might crowd out microfinance.

In addition, by means of usury laws, lawmakers establish interest rate ceilings to protect clients from being exploited. However, they have a negative impact on the financial viability of MFIs and supply of credit to the micro enterprise sector. The laws prevent microfinance organisations from charging market clearing interest rates that are high enough to cover the high per unit cost of microfinance and they induce the institutions to screen out clients with the highest credit risk. This induces MFIs to seek ways to circumvent restrictive interest rate ceilings (Jansson and Wenner, 1997).

Barr (2004) supports these arguments and suggests that restrictive interest rates and other controls can make MFIs unsustainable, unprofitable and more inefficient. In addition, he proposes that licensing restrictions can also hamper the growth of MFIs by preventing non-profit, nongovernmental organisations from providing credit.

2.1.3 Financial Regulation of Micro Finance Institutions

Why MFIs should be regulated

Since many microfinance organizations recently start to make the transition from unregulated NGOs (non-governmental organisations) to regulated financial institutions, there is a growing discussion in the literature about the effect of financial regulation on MFI performance and can not be left out of analysis when examining the performance of MFIs.

The basic principle of financial regulation and supervision is the objective to protect financial systems from unsound practices by deposit taking organisations and thereby to protect a country's payment system and small, uninformed depositors (Vogel et al., 1999). Its fundamental purpose is to promote effective and efficient capital accumulation and resource allocation while maintaining the safety and soundness of financial institutions that take deposits from the public. Supervisory authorities achieve this by imposing various restrictions on risk exposure, accounting and reporting practices and operations of financial institutions (Jansson and Wenner, 1997). Moreover, an institutional transformation of a micro-finance NGO into a regulated financial institution is seen as one of the most effective strategies for achieving significant economies of scale and scope by offering adequate service to its clients. Links to regulators and other banking expertise would result in accessing commercial sources of capital, because being regulated act as a 'signal' to investors that the financial institution is financially sound. In addition, it helps to improve operational efficiency through enhanced systems, controls and transparency in reporting (Hishigsuren, 2006). Moreover, according to Cristen (2000) regulated MFIs are far more sustainable than unregulated MFIs even though many of them started out as unregulated institutions routed in the non-profit sector. Finally, as suggested by proponents of commercial banking regulation, regulation of microfinance organisations is necessary to offset market failures due the existence of information asymmetry and monopoly power. Neither private nor official entities can effectively monitor complex bank organisations (Barth et al., 2004).

Why MFIs should be unregulated

As suggested earlier in this paper MFIs differ from other financial institutions with conventional client bases in principally three areas: lending methodology, composition of loan portfolio and institutional settings (table 1).

Table 1: Distinctive features of Micro Finance

AREA	Traditional Finance	Microfinance
Lending Methodology	(1) based on collateral (2) more documentation (3) less labor intensive	(1) based on character (2) less documentation (3) more labor intensive
Loan Portfolio	(1) fewer loans (2) loans larger in size (3) collateralized (4) longer maturity (5) more stable delinquency	(1) more loans (2) loans smaller in size (3) uncollateralized (4) shorter maturity (5) more volatile delinquency
Institutional Structure and Governance (of regulated financial institutions)	(1) Profit maximizing institutional and individual shareholders (2) Creation by spin-off from existing regulated institution (3) Centralized organization with branch office located in cities	(1) Mainly non-profit institutional shareholders (2) Creation by conversion from NGO (3) Decentralized set of small units in areas with weak infrastructure

Source: Jannson and Wenner (1997)

These differences make it not immediately evident that financial regulation in general is effective for microfinance institutions.

First of all, absence of permits, authorizations and low initial amount of fixed capital requirement to start up an economic activity that comes with regulation, make it possible to start up a business with low initial credit where the moral hazard is high (Ciravegna, 2006). This leads to a growing demand for micro credit and increases the performance of MFIs.

Secondly, traditional regulation and supervision requires loan documentation of borrowers to ensure collateral and financial stability. This documentation will however be impossible for microfinance institutions because they rely on guarantee structures (such as joint liability) and not on collateral. Besides, these documents are of secondary importance to microfinance credit decisions and are not kept on a regular basis (Jansson and Wenner, 1997). Jansson and Werner also discuss the operational restrictions of governments that can harm the efficiency of MFIs. MFIs' branch offices need to be located close to the community they serve, because low-income people have limited ability to travel and scarce access to usage of electronic systems to carry out transactions. MFIs need flexibility in adapting to operations and services

to a level that is appropriate for the communities they serve. This requires a flexible, less restricted regulatory framework (flexible opening hours and delivery of financial services). Further, Hartarska and Nadolnyak (2007) did not find evidence that regulated MFIs achieve better operational self-sustainability and overall financial results than unregulated MFIs.

Finally, an exceptional finding by Chinn and Ito (2005) shows that institutional quality benefits financial performance, but only if a certain threshold of rules and regulation has been achieved. This does not only indicate the importance of regulation for financial performance, but also suggests that the impact of institutions on performance may be dependent on regulation. This points to the possibility that MFIs can only conform the rules and restrictions of well-developed institutions if it is regulated.

Once again the contrasting literature poses question marks over the relation between regulation and MFI performance and more interesting the different impact that institutions may have on MFI performance after accounting for whether the MFI is regulated or not.

3. Research Questions and Expectations

RQ1: What is the impact of institutions on the performance of microfinance organisations?

This research question concerns the contradiction in the literature, where one stand suggests that well-developed institutions are fundamental for development of financial organisations and in particular MFIs, while the other stand proposes that well-developed institutions may not always be good and even be bad for the performance of MFIs.

RQ2: Do regulated MFIs perform better than unregulated MFIs?

This research question concerns the effect of financial regulation on MFI performance, which according to literature is ambiguous.

RQ3: Does the impact of institutions on MFI performance change if the MFI is regulated?

This research question considers the possibility that the effect of institutions on MFI performance may be dependent on whether or not the MFI is regulated.

4. Methodology

4.1 Efficiency Measures

For financial organisations it is often important to measure their economic performance relative to other firms in the industry. Traditionally, this has been done by using financial ratios, such as expense to premium ratios, return on assets and return on equity. This type of measurement has for a great part been substituted by frontier efficiency methodologies. Efficiency refers to how well firms are performing relative to the existing technology in the industry (Cummin and Weiss, 1998). Efficiency is different from productivity, which refers to the evolution of technology over time.

Frontier methodologies involve the construction of the best practice frontier and measure inefficiency relative to this frontier. They summarize firm performance in a single statistic that controls for differences among firms in a multidimensional framework that has its roots in economic theory.

Frontier methods are useful in several contexts. One important application is to inform management about the effects of policies, procedures, strategies and technologies adopted by the firm. It can track the evolution of a firm's efficiency and productivity over time and can compare the performance of departments, divisions or branches within the firm. Frontier analysis provides more meaningful information than the conventional performance ratios, which involves masses of statistics that are difficult to summarize in one or a few performance measures (Cummin and Weiss, 1998). Furthermore, it can be applied to measure total factor productivity (TFP). TFP growth can be analyzed for correlations with various micro- and macro-economic conditions to determine the drivers of economic growth.

Another application is to compare economic performance across countries. For example, Maudos et al. (1999) compare banking efficiency in various European nations.

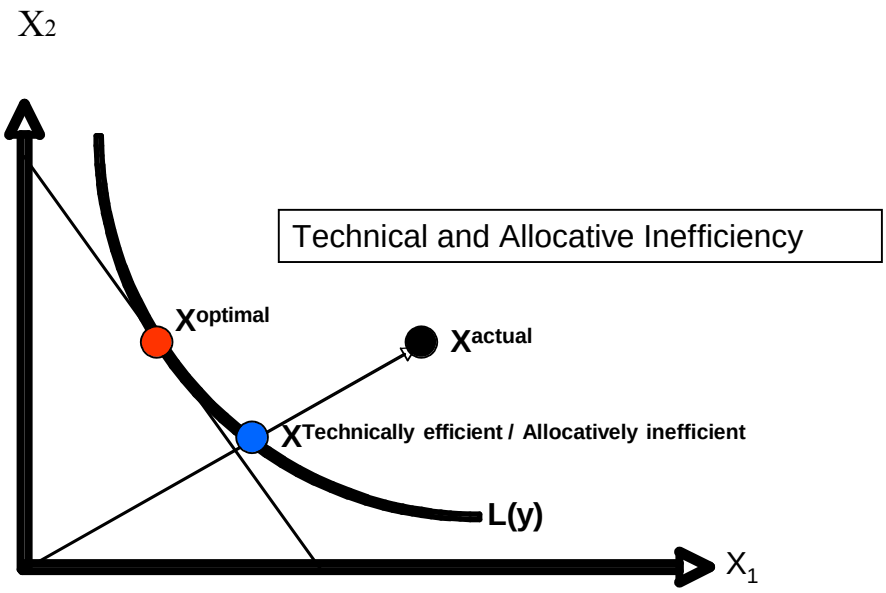
4.1.1 Production Efficiency

The first studies on efficiency estimation focused on production efficiency. Farrel (1957) identified two components of production efficiency: technical efficiency, which measures a firm's success in producing maximum output from a given set of inputs; and allocative efficiency, which measures a firm's success in choosing an optimal set of inputs. Together they are also known as X-efficiency. Deviations of actual production costs from minimum production costs (production frontier) are due to technical and allocative inefficiencies.

Removal of these technical and allocative efficiencies will yield efficient production. The production frontier represents the maximum output attainable from each input level and reflects the current state of technology in the industry. Firms in the industry operate on this production frontier if they are technically efficient.

Figure 1 gives an example of a firm that is operating in a technically and allocatively *inefficient* manner. Firms operating on the isoquant L(y) are technically efficient. The optimal operating point is $X_{optimal}$ (the tangency between the isoquant L(y) and the isocost line). At $X_{optimal}$, a firm is considered to be fully efficient. At point X_{actual}, the firm exhibits both technical and allocative inefficiency. Technical inefficiency results from not operating at the best-technology isoquant L(y). Allocative inefficiency results from not using the inputs in the right proportions. The firm is using too much of input 2 and too little of input 1. At $X_{technically\ efficient/allocatively\ inefficient}$ the firm is operating on the isoquant and technically efficient, but not using its inputs in the right proportions and still allocatively inefficient.

Figure 1: Technical and Allocative Inefficiency



Source: Greene, W. (2007)

Economic representations of the structure of production technology include cost, revenue and profit frontiers. These frontiers are used as standards against which cost, revenue and profit efficiency are measured (optimization). Cost, revenue and profit efficiency require price information and the imposition of an appropriate behavioural objective on producers to be determined (producers' ability to freely adjust use of inputs). With the help of frontiers these

efficiencies are defined in terms of distance to an economic frontier. Most studies use cost and profit efficiency measures. They are discussed in the following section.

4.1.2 Cost Versus Profit Efficiency

Profit efficiency is a wider concept than cost efficiency as it combines both costs and revenues in the measurement of efficiency. Actually, this is the main difference between the two frameworks of optimization, as cost efficiency only minimizes costs, whereas profit efficiency minimizes costs and maximizes revenue.

Most performance evaluation studies have been concentrated on cost efficiency measures. Some empirical evidence shows however that profit efficiency is of greater quantitative importance than cost efficiency. This evidence suggests that the most important inefficiency is on the revenue side, either due to the choice of a production composition that is not the most suitable given the prices of services, or due to the establishment of bad pricing policy (Kasman and Yildirim, 2006).

Nevertheless, cost minimization is an appropriate measure to estimate cost efficiency, especially in competitive environments, in which input prices and output are exogenous (output is demand driven). In addition, not all MFIs in the sample used for this study are profit seeking. Measuring profit efficiency for this type of MFIs would not be appropriate. Therefore, cost efficiency is used to evaluate MFI performance and is explained in the following section.

4.1.3 Cost Efficiency

Cost efficiency is the ratio between the minimum cost at which it is possible to attain a given volume of production and the cost actually incurred. Firms will minimize costs if they are technically and allocatively efficient. Cost efficiency is measured against the cost frontier and estimation requires an input oriented approach.

The cost of a financial institutions depends on the output vector *(y),* the price of inputs *(w),* the level of cost efficiency *(u)* and a set of random factors *(v)* which incorporate the effects of errors in the measurement of variables, bad luck, etc. The cost function is expressed as follows:

$$C = C(y, w, u, v)$$

or in logarithmic terms (assumed that the efficiency and random error terms are multiplicatively separable from the remaining arguments of the cost function),

$$ln\ C = f(y, w) + ln\ u + ln\ v$$

If E_c represents the efficiency value of costs, E_c is measured as the ratio between minimum costs (C_{min}) necessary to produce the output vector and the actual costs incurred (C), and are expressed as follows:

$$E_c = C_{min}/C = exp\ (f\ (y,w)\ )exp\ (ln\ v)\ /\ exp\ (f\ (y,\ w)\ )exp\ (ln\ u)\ exp\ (ln\ v) = exp\ (-u)$$

4.2 Stochastic Frontier Analysis

4.2.1 Advantages of Stochastic Frontier Analysis

In the financial sectors the most commonly used approaches to measure cost inefficiency are stochastic frontier analysis (SFA) and data envelope analysis (DEA).

Both approaches use frontier models to explain optimal behaviour instead of average behaviour (as with ordinary regression).

DEA assumes that all deviations between observed costs and the minimum costs of the frontier are due to inefficient behaviour. SFA proposes that observed costs of a financial institution might deviate from the cost frontier either because of random fluctuations, inefficiency or because of both. An asymmetrical distribution function for the inefficiency term is assumed to separate the two components. In addition, stochastic analysis allows for estimation of the probability distributions governing the data. Furthermore, SFA models optimization problems that involve uncertainty or unknown parameters. Finally, SFA is a parametric method for estimation of production frontiers, whereas DEA is a non-parametric method. An advantage of a parametric technique over a non-parametric technique is that it is able to control for unobserved heterogeneity among organisations and more importantly it controls for 'noise' (which causes inefficiency) and measurement error. In addition, parametric techniques are robust; they retain power to detect differences or similarities even when assumptions are violated. This makes a parametric method such as SFA a justified methodology.

In the estimation of the stochastic cost frontier, efficiency measurement is input oriented and is concerned with the behavioural objective on producers.

4.2.2 Stochastic Cost Frontier Framework

This study applies the stochastic cost frontier model developed by Battese and Coelli (1995) to solve the influence of exogenous factors on efficiency. This framework is able to model cost relationships and determinants of inefficiency in one stage instead of in two stages. The 'two stages' approach creates biased coefficients due to differences in the distribution of the efficiency term (Wang and Schmidt, 2002).

The stochastic frontier regression has a two-part composed error term, the standard random error component (two-sided and normally distributed) and the one-sided random efficiency component (with a truncated normal distribution). The standard error term concerns the measurement of errors and other random factors or random symmetric statistical noise, while the random efficiency term measures the distance of the observation from the cost frontier/deviations from the frontier (technical inefficiency) and the proportional use of inputs (allocative inefficiency). The efficiency component combines technical and allocative efficiency into economic efficiency (Stevens, 2004).

The original stochastic production frontier was developed by Aginer, Lovell and Schmidt (1977) and is specified as follows:

$$\mathrm{Y} = f(x_i,\beta) + \varepsilon_i$$

$$\varepsilon_i = \nu_i - \upsilon_i, \quad \upsilon_i \textit{ is non-negative}$$

Y is the observed output; x_i is the vector of inputs and β a vector of unknown parameters. ε_i is the combined error term, where ν_i represents the standard error term and υ_i the inefficiency term. Here the inefficiency component is *subtracted* in the cost frontier, because the production function represents maximum output.

Battese and Coelli (1995) specified a cost model for technical inefficiency effects in a stochastic frontier production function for panel data.

The general stochastic cost frontier is specified as follows:

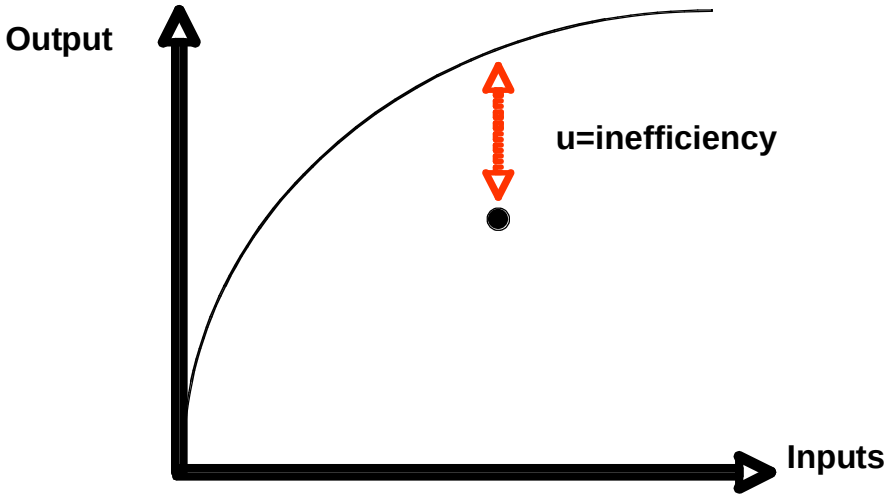
$$\ln C_{i,t} = C(Y_{i,t}, W_{i,t}, Q_{i,t}; \beta) + U_{i,t} + V_{i,t}$$

where $C_{i,t}$ is the total cost firm i faces at time t; $Y_{i,t}$ is the logarithm of output of firm i at time t; $W_{i,t}$ is a vector of the logarithm of input prices of firm i at time t; Q are firm specific control variables and β is a vector of all unknown parameters to be estimated. The inefficiency

component is *added* in the cost frontier, because the cost function represents minimum costs. The inefficiency term $U_{i,t}$ now defines how far the firm operates above the cost frontier. Moreover, $U_{i,t}$ captures the cost inefficiency term and measures the deficiency in output away from the maximum possible output given by the stochastic cost frontier $C(Y_{i,t},W_{i,t};\beta)$. $U_{i,t}$ is independent and has to be non-negative, which ensures that all outputs should lie on or below the stochastic frontier.

The following figure represents an example of cost inefficiency:

Figure 2: Graphical demonstration inefficiency



Source: Greene, W. (2007)

With respect to the distribution of the inefficiency term a truncated normal distribution will be used. The truncated normal distribution allows for a wider range of distributional shapes, including non-zero modes (exponential and half-normal distribution functions have a mode at zero implying that a high proportion of the firms being examined are perfectly efficient).[3]

$V_{i,t}$ is the random error term, which captures statistical noise such as random effects of measurement errors and external shocks out of control. $V_{i,t}$ has a normal distribution and is independently and identically distributed.

The two parts of the error term can be represented as:

[3] See appendix figure 3 for graphical demonstration of different distribution functions.

$$U_{i,t} \sim N + (m_{i,t}, \sigma^2)$$
$$V_{i,t} \sim iddN(0, \sigma^2)$$

where $m_{i,t}$ is the inefficiency of firm *i* and specified as follows:

$$m_{i,t} = \delta_0 + \Sigma \delta_{n,i,t} Z_{n,i,t}$$

Z represents the vector of *n* variables that determine the inefficiency of firm *i* at time *t* and δ represents the corresponding coefficients.
Assumed is that both error components are independent of each other and the input variables *(x)*. Therefore a likelihood function can be defined and maximum likelihood estimates can be computed. The stochastic cost frontier and the inefficiency model are solved in one-step by means of maximum likelihood. This method is proposed for simultaneous estimation of parameters of the stochastic frontier and the model for the technical efficiency effects. The function is expressed in terms of the variance parameters:

$\sigma^2 = \sigma^2_v + \sigma^2_u$ *and* $\gamma = \sigma^2_u / \sigma^2$

The estimated coefficients in the inefficiency model are of particular interest to this study. If the estimate of the variance parameter, γ, is close to one this indicates that the inefficiency effects are likely to be highly significant in the analysis of the value of the total costs of a firm. Generalized likelihood-ratio tests of null hypotheses show whether inefficiency effects are present or absent (Battese and Coelli, 1995). The test has a chi-square distribution and looks as follows:

λ*= -2 (log (likelihood(H0)) – log (likelihood(H1)))*

For the specification of the input and output variables the intermediation approach of banking is used, where banks are considered as intermediates of financial services, rather than producers of service accounts and transactions, or the borrowers and subsequent lenders of funds (Mester, 1987).
The classification of input and output variables was developed by Hancock (1986), which used the concept of ‘user cost’ as methodology to identify individual financial

assets/liabilities as inputs or outputs. Variables with a negative user cost and positive returns were identified as output variables, while those with positive user costs and negative returns were identified as input variables.

4.3 Stochastic Cost Frontier Regression to Measure MFI Performance

The stochastic cost frontier regression in this study estimates a stochastic cost frontier and measures operational efficiency (performance) of MFIs.

Total cost of a MFI will be a function of input prices and output quantities. This leads to the following classification of input and output variables (Lensink, Meesters & Hermes, 2007):

Inputs: *(1) labour expense (salaries and employee benefits), (2) interest expense (rent)*
Output: *(3) gross loan portfolio*

Since MFIs are labour intensive it is essential to include salary in the cost equation. In addition, a financial organisation always copes with interest expense and rent is therefore another crucial variable to include in the cost equation. Finally, the main product of MFIs is a loan, which makes gross loan portfolio the output variable of the cost function.

In addition to inputs and output a dummy variable is included, which controls for different types of MFIs (banks, cooperatives, non-bank financial institutions, non-governmental organizations, rural banks and other organizations), a distinction provided by MIXMarket, a global web-based microfinance information platform.

Because MIXMarket lacks directly available data on salary, interest expenses and gross loan portfolio some calculations are made to come to the necessary input and output variables (Lensink, Meesters & Hermes, 2007).

Because of the labour-intensive nature of the operations of MFIs, labour expenses are an important determinant of their total costs. Salaries are captured in a firm's operating expenses, which are the costs of administering and managing a mutual fund. Since the operations of MFIs are principally labour-intensive, labour costs capture a large part of their operating costs (Yencho, T., 2006). In other words, one way of calculating labour expenses is dividing operating expense by the total number of employees. The calculation results in the following equation for the first input variable:

(1) Labour expense = ((operating expenses / total assets) x total assets) / total nr employees

Since MFIs are financial institutions that are considered as intermediates of financial services, interest expenses and earnings constitute an important part their total costs.
To be able to provide money to the poor, MFIs borrow money. Expenses incurred are the interest expenses of holding money. Interest expenses are part of the financial expenses of a firm, which are composed of interest, income taxes and other such expenditures incurred in owning or borrowing an asset. In contrast to the interest expenses of holding money, the deposits of a MFI bring in interest earned (revenues) (Brealy, Myers and Marcus, 2001). Processing the two ratios (financial expenses to total assets and total deposits to total assets) results in the following equation for the second input variable:

(2) Interest expense = ((financial expenses / total assets) / (total deposits / total assets))

In the cost function gross loan portfolio represents the output variable (the user costs of the loan portfolio are negative, whereas the return on the portfolio or portfolio yield is positive), which is defined as all outstanding principal for all outstanding client loans (MIXMarket). The calculation for the output variable is done as follows:

(3) Gross loan portfolio = (gross loan portfolio/total assets) x total assets

The three explanatory variables are added to the cost frontier as individual variables.[4]
Furthermore, interaction variables are included (in the cost frontier as well as the inefficiency equation) to account for interaction between the explanatory variables in the regression. This situation is described as one where the effect of one explanatory variable on the outcome is affected by the value of another explanatory variable.
There are several advantages of including a multiplicative term. First, if an interaction does in fact exist and is not included in the estimation, this creates a specification error in the form of omitted variable bias. An estimation that fails to account for the interaction does not provide an accurate relationship between the dependent and independent variables. Next to providing a more accurate relationship the inclusion of an interaction term also explains more of the variation in the dependent variable.

[4] Since a cost function often reflects a nonlinear (curvilinear) relation and the cost regression model may better fit a curve instead of a straight line, a polynomial model of second degree is also estimated. Because only the quadrant of GLP turned out to be significant and overall results do not change much when leaving out the quadrants, the focus will be on the polynomial of first degree (see appendix 3 table 1 for estimation results of the polynomial of second degree).

The cost function is specified in logarithms and looks as follows:

$$\ln(TC_{i,t}) = \beta_0 + \beta_1 \ln(SALARY_{i,t}) + \beta_2 \ln(R_{i,t}) + \beta_3 \ln(GLP_{i,t}) + \beta_4 \ln(SALARY_{i,t}) \ln(R_{i,t})$$
$$+ \beta_5 \ln(SALARY_{i,t}) \ln(GLP_{i,t}) + \beta_6 \ln(R_{i,t}) \ln(GLP_{i,t}) + \beta_{j=10...14}(MFITYPE_{i,t}) + \upsilon_{i,t} + \nu_{i,t}$$

$\upsilon_i \sim N + (m_{i,t}, \sigma^2)$ = *inefficiency term*

$\nu_i \sim iddN(0, \sigma^2)$ = *random error term*

Positive relations between total costs and all explanatory variables are expected i.e. an increase in salary, interest expense and gross loan portfolio will increase the total costs of the MFI. With respect to the dummy variable for MFI type, it is expected that non-profit MFIs incur the lowest total costs because they are mainly self-regulated and therefore not subjected to costly rules and regulations (Greuning et al, 1998).

Efficiency captured in the additional error term is measured by another regression equation. For this an inefficiency model is used, where institutions are included as one of the explanatory variables and inefficiency is the dependent variable.

The inefficiency model is specified as follows:

$$m_{i,t} = \delta_0 + \delta_1 \, INSTITUTIONS + \delta_2 \, LOANTYPE + \delta_3 \, AGE + \delta_4 \, REGION + \delta_5 \, REGULATED$$
$$+ \delta_6 \, (INSTITUTIONS*REGULATED)$$

The institutional variable (*INSTITUTIONS*) represents six governance indicators developed by Kaufman et al. (2006). The six dimensions are aggregated governance indicators and based on over hundred disaggregated individual variables that measure various dimensions of governance.

The institutional variables are defined as follows:

1. *Voice and Accountability:* measures the extent to which a country's citizens are able to participate in selecting their government and the extent of freedom of expression, association and media.
2. *Political Stability and Absence of Violence:* measures perceptions of the likelihood that government will be destabilized or overthrown by possible unconstitutional and/or violent means, including domestic violence and terrorism.

3. *Government Effectiveness:* measures the quality of public and civil services and the degree of its independence from political pressures and the quality of policy formulation and implementation and the credibility of the governments commitment to such policies.
4. *Regulatory Quality:* measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development
5. *Rule of Law:* measures the extent to which agents have confidence in and abide the rules of society, which includes the quality of contract enforcement, police, the court and the incidence of crime and violence.
6. *Control of Corruption:* measures the extent to which public power is exercised for private gain, including petty and grand forms of corruption and capture of the state by elites and private interests.

Each of the indicators is estimated by a value between -2 and 2 for each country in the sample, where a higher value corresponds to higher quality of the particular indicator.
Since the institutional indicators are highly correlated, including them in the regression as individual explanatory variables will not yield reliable results. Therefore, principal component analysis (PCA) is applied, which lowers the dimensions for analysis and results in one factor (that explains for the six indicators) to be included in the regression equation (see section 6).
LOANTYPE is a dummy variable indicating which type of loan a MFI provides the most (individual, group, village, mixed). The expectation is that group loans have the most beneficial effect on efficiency, because this type of borrowers most often pays its rents and repays its loans. *AGE* is a dummy variable and controls for the number of years of a MFI since its establishment. The effect of age on a MFI concerns the learning curve. Older MFIs have more experience, which may come along with higher performance. On the other hand, younger MFIs could be more efficient through flexibility and focus on innovation.
Furthermore, efficiency may depend on country region and therefore the dummy variable *REGION* is added, which refers to different country regions. Five different dummies are included, referring to Africa, East Asia and Pacific, Eastern Europe and Central Asia, Latin America and the Caribbean and the Middle East and North Africa.
Finally, *REGULATED* implies whether or not the MFI is regulated. The majority of unregulated MFIs are non-profit organisations or NGOs, whereas most regulated MFIs are typified as banks. Because restrictions affect operational efficiency of MFIs, this dummy is

added to the equation. According to literature, the coefficient of the dummy can take a positive or negative sign. The interaction term *(INSTITUTIONS*REGULATED)* is included to account for the possibility that regulation of the MFI modifies the influence institutions have on the inefficiency of the MFI.

5. Data requirements and sources

The estimation is based on panel data with a sample size covering more than 1200 observations (table 2).

Table 2: Description of the panel: Number of MFIs per year

Year	Nr of MFIs of which data is available for specific year
1996	9
1997	19
1998	38
1999	56
2000	87
2001	111
2002	145
2003	170
2004	186
2005	198
2006	198
Total	1256

Table 3: Description of the panel: Number of year observations per MFI

Year observations	Number of MFIs
1	1
2	10
3	27
4	36
5	30
6	32
7	32
8	17
9	18
10	22
11	13
Total	244

Data comes from 244 MFIs located in 59 different developing countries for 11 years (1996-2006)(table 3).[5] Governance indicators for the years 1996-2006 are available and drawn from the latest update of the Worldwide Governance Indicators (WGI) research project (Kaufmann et al., 2006). The project covers 212 countries and territories and measures the six dimensions of governance (see section 4). The data are collected from 33 distinctive data sources.

Data on MFIs are taken from MIXMarket, a global web-based microfinance information platform, and is available for the years 1997-2007.

[5] Since not all MFIs have available data for all years, the total sample size is smaller than the number of MFIs times the number of years (see tables 2 and 3)

The composition of the sample is based on the diamond system, to which all MFI members of MIXMarket participate. The diamond system reflects the level of disclosure for each MFI: the higher the number of diamonds, the higher the level of disclosure. The number of diamonds ranges from one to five. This study uses a sample of MFIs that are represented by five diamonds because for these MFIs most data is available (see table 4 for a description of the diamond system).

Table 4: Diamond System

Level	Disclosure Requirements	Diamonds
1	General information	One
2	Level 1 and outreach and impact data (minimum two consecutive years of data)	Two
3	Level 1-2 and financial data (minimum two consecutive years of data)	Three
4	Level 1-3 and audited financial statements of audited financial statements (minimum two consecutive years of data, including auditor's opinion and notes)	Four
5	Level 1-4 and adjusted data (such as ratings/evaluation, due diligence an other benchmarking assessment reports or studies)	Five

Source: MIXMarket

The following tables offer a description of data comprising the sample used for the estimation. First, data comes from MFIs located in five different regions: *Africa*, *East Asia and Pacific, Eastern Europe and Central Asia, Latin America and the Caribbean and the Middle East and North Africa*. Most MFIs in the sample are located in *Latin America*, while the least are located in *East Asia and the Pacific* (see table 5 for the distribution of MFIs across regions). [6]

Table 5: Number of MFIs per region

region	Freq.	Percent	Cum.
Africa	288	19.61	19.61
East Asia and the Pacific	102	6.94	26.55
Eastern Europe and Central Asia	291	19.81	46.36
Latin America and The Caribbean	678	46.15	92.51
Middle East and North Africa	110	7.49	100.0
Total	1,469	100.00	

Second, the estimation includes six different MFI types: *Banks, Cooperatives, Non-Bank Financial Institutions, Non-Profit or Non-Governmental Organizations, Rural Banks and*

[6] See appendix 5 table 3 for the distribution of MFIs across countries

Other Organizations. Most MFIs are *Non-Profit (NGOs)* while only few are *Rural Banks* (see table 6).

Table 6: Distribution of MFI types

currentlegalstatus	Freq.	Percent	Cum.
Bank	167	10.15	10.15
Cooperative/Credit Union	127	7.72	17.86
Non-Bank Financial Institution	617	37.48	55.35
Non-Profit (NGO)	682	41.43	96.78
Other	45	2.73	99.51
Rural Bank	8	0.49	100.00
Total	1,646	100.00	

In addition, all MFIs are either regulated or unregulated. Table 7 shows the distribution of MFI regulation.

Table 7: Number of regulated versus unregulated MFIs

regulated	Freq.	Percent	Cum.
No	612	37.18	37.18
Yes	1,034	62.82	100.00
Total	1,646	100.00	

Finally, with respect to the type of loan a MFI provides, a distinction is made between *Individual, Group (Solidarity), Village and Mixed (Individual/Solidarity)*. Table 8 provides the distribution.

Table 8: Distribution of loan type MFIs provide

loantype	Freq.	Percent	Cum.
Individual	238	26.65	26.65
Individual/Solidarity	414	46.36	73.01
Solidarity	119	13.33	86.34
Village Banking	122	13.66	100.00
Total	893	100.00	

Some noteworthy description results are that the data indicate that MFIs located in *Latin America* dominate the sample. Almost half of the MFIs in the sample are located in this region. The other half is distributed more evenly across the other regions. One should bear this in mind while interpreting the estimation results. In addition, almost 80% of the MFIs used for the sample *are Non-Profit (NGOs)* and *Non-Bank Financial Institution,* whereas *Banks* only account for 10% of the sample.

6. Estimation Results and Interpretation

This section shows several estimation results with regard to the impact of institutions and regulation on MFI performance.

First, the control variables of the cost frontier are tested for correlation. The results show that there is no extremely high correlation between them and therefore they can be used in the cost frontier as proposed in the former section (see table 9).

Table 9: Correlation matrix control variables cost frontier

	lnsalary	lnglp	lninte~p
lnsalary	1.0000		
lnglp	0.6381	1.0000	
lninterest~p	-0.2786	-0.2546	1.0000

As mentioned in section 4.3 the institutional indicators are rather correlated (see table 10) and therefore principal component analysis (PCA) is applied, which results in one factor to be included in the inefficiency equation that explains for more than 60% of the variance of all the six indicators (see table 11).

Table 10*:* Correlation matrix institutional variables

	voiacc	polstab	goveff	regqual	rulelaw	concor
voiacc	1.0000					
polstab	0.4891	1.0000				
goveff	0.5443	0.3488	1.0000			
regqual	0.4930	0.3019	0.7525	1.0000		
rulelaw	0.5165	0.4306	0.7181	0.4948	1.0000	
concor	0.5328	0.3426	0.7304	0.5868	0.7302	1.0000

Table 11: Principal Component Analysis Institutional Variables

Principal components/correlation — Number of obs = 1508
Number of comp. = 6
Trace = 6
Rotation: (unrotated = principal) — Rho = 1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.72107	2.87155	0.6202	0.6202
Comp2	.849529	.305811	0.1416	0.7618
Comp3	.543718	.0921131	0.0906	0.8524
Comp4	.451605	.192054	0.0753	0.9277
Comp5	.259551	.0850285	0.0433	0.9709
Comp6	.174522	.	0.0291	1.0000

Note: From the first component in the column *cumulative* can be derived that one factor explains for 62.02% of the variance of all the six variables. Therefore including one factor in the regression equation is enough.

Table 12 shows the results of the stochastic cost frontier estimation, where this factor is included in the regression. Table 13 shows the corresponding list of definitions of output variables.

Table 12: Stochastic Cost Regression results

```
note: dumbank dropped because of collinearity
note: dumcmiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    5318.59
Log likelihood = -143.51971                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.036743*** .2099134     4.94   0.000  .6253208    1.448166
       lnglp |    1.04367*** .1211657     8.61   0.000  .8061892     1.28115
lninterest~p |   .1881035    .1805725     1.04   0.298 -.1658122    .5420191
       var12 |  -.0348089*** .0135521    -2.57   0.010 -.0613704   -.0082473
       var13 |   .0143575    .0207946     0.69   0.490 -.0263992    .0551141
       var23 |  -.0232236*** .008624     -2.69   0.007 -.0401263    -.006321
     dumcoop |  -.7261258*** .0655995   -11.07   0.000 -.8546984   -.5975532
  dumnonbank |   .0668269    .0778161     0.86   0.390 -.0856899    .2193436
 dumnonpro~t |  -.0831853    .0816709    -1.02   0.308 -.2432573    .0768868
      dumrur |   .1166863    .1965522     0.59   0.553 -.2685488    .5019215
       _cons |  -6.655174   1.802992     -3.69   0.000 -10.18897   -3.121375
-------------+----------------------------------------------------------------
mu           |
Institutions |   .1331679***.0439134     3.03   0.002     .0470991    .2192366
         age |   .0172555    .0115772     1.49   0.136    -.0054354    .0399464
    dumindiv |  -.2217267    .2566217    -0.86   0.388     -.724696    .2812427
      dumsol |  -.1415923    .2595356    -0.55   0.585    -.6502726    .3670881
      dummix |  -.1120448    .1458472    -0.77   0.442       -.3979    .1738104
     dumvill |   .0492385    .2391901     0.21   0.837    -.4195654    .5180425
   dumafrica |  -.6083321***.2366881    -2.57   0.010    -1.072232   -.1444319
 dumeastasia |  -.1818786    .1923628    -0.95   0.344    -.5589028    .1951456
    dumlatin |  -.7090632***.2766972    -2.56   0.010     -1.25138   -.1667466
       _cons |   .3308368    .3040084     1.09   0.276    -.2650086    .9266823
-------------+----------------------------------------------------------------
   /lnsigma2 |  -1.205239    .2692195    -4.48   0.000      -1.7329   -.6775789
  /ilgtgamma |   1.601183    .4130861     3.88   0.000     .7915495    2.410817
-------------+----------------------------------------------------------------
      sigma2 |   .2996202    .0806636                      .176771     .507845
       gamma |   .8321837    .0576891                     .6881639    .9176485
    sigma_u2 |   .2493391    .0789508                     .0945983    .4040798
    sigma_v2 |   .0502812    .0139266                     .0229855    .0775769
------------------------------------------------------------------------------
```

Notes: (1)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(2)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(3)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Table 13: List of the output variables and corresponding meaning

lntotalcost	ln(totalcost)
lnsalary	ln(salary)
lnglp	ln(gross loan portfolio)
lninterest	ln(interestexpense)
var12	ln(salary)*ln(glp)

var13	ln(salary)*ln(interestexpense)
var23	ln(glp)*ln(interestexpense)
dumcoop	dummy for MFI type: cooperative
dumnonbank	dummy for MFI type: non-bank
dumnonprofit	dummy for MFI type: nonprofit
dumrur	dummy for MFI type: rural
dumbank	dummy for MFI type: bank
Institutions	Institutions (one factor that represents the six indicators)
age	nr of years of MFI since its establishment
dumindiv	dummy for loantype MFI provides: individual
dumsol	dummy for loantype MFI provides: solidarity/group
dummix	dummy for loantype MFI provides: individual&group
dumvill	dummy for loantype MFI provides: village
dumafrica	dummy for region MFI is located: africa
dumeastasia	dummy for region MFI is located: eastasia
dumlatin	dummy for region MFI is located: dumlatin
dumreg2	dummy for regulated MFI
instreg	(dumreg2*Institutions)

The first part of table 12 shows the estimation results of the cost frontier. A positive coefficient suggests an outward shift of the cost function, which corresponds to higher total costs for the MFI. With respect to the vector of dummies that controls for MFI type, the dummy variable *Other* acts as reference group against which the other dummies are assessed. Therefore, this dummy is left out of empirical analysis. The results show that the explanatory variables *(ln)SALARY* and *(ln)GLP* are highly significant and positively correlated with *(ln)Total Costs*. This is in line with the expectation that higher salaries and greater gross loan portfolios come along with higher costs. The coefficient of *(ln)Interest Expenses (R)* is negative but does not appear to be significant. Furthermore, two out of three interaction terms in the cost frontier show a significant correlation with total costs, while the individual effects of salary and GLP also remain significant.[7] In other words, salary and GLP (by itself) still appear to be significant explanatory factors, but salary also affects total costs through its interaction with gross loan portfolio and gross loan portfolio affects total costs through its interaction with interest expenses.[8]

[7] The significant interaction variables are: var12=lnsalary*lnglp and var23=lnglp*lninterestexpense

[8] Estimation of the regression without the interaction terms did result in a significant sign for the coefficient of (R), whereas it did not with inclusion of the interaction term (R*GLP). This indicates that interest expenses only affect total costs through its interaction with GLP

Finally, with respect to the dummy for MFI type, *dumcoop* (cooperative MFIs) appears to have a significant negative coefficient. This suggests that cooperative MFIs have less influence on total costs than the reference group (*Other*).

Yet, the main focus of this study is on the impact of institutions on MFI performance captured in the inefficiency equation (recall that performance is measured by inefficiency). The estimation of the inefficiency regression is shown in the second part of table 12. First of all, no conclusion can be drawn from the coefficient of the variable AGE, since it turns out to be insignificant. The reference dummies for REGION and LOANTYPE are respectively *Eastern Europe/ Central Asia* and MFIs that did not report on their loan type (and are left out of analysis). Only two of the added region dummies are significant (*dumafrica and dumlatin*) and have a negative slope. This implies that MFIs operating in the region Africa or Latin America/Caribbean are generally less *inefficient* than the ones operating in the reference group region (Eastern Europe and Central Asia).

More importantly, the factor *(Institutions)* that explains for all six institutional indicators has a significant and positive effect on inefficiency. This means that well-developed institutions result in an increase in *inefficiency* or stated otherwise: less developed institutions make the MFI perform more *efficiently*. This result contradicts the generally accepted view, which considers institutional quality as an essential factor for efficient operation of financial institutions. Yet, it supports the recent developed suggestion that institutional quality is bad for MFI performance.

Table 14 shows the stochastic regression estimation where the dummy variable for regulation is included. Some results in the cost frontier have changed after inclusion of this dummy. All interaction variables *(var12/var13/var23)* now appear to be highly significant. In addition, all dummy variables for MFI type turn out to have positive coefficients that are highly significant. This implies that all MFI types included in the regression have more influence on the total cost of the MFI than the reference group *Other*. More interesting, the coefficient of the factor *Institutions* remains positive and highly significant and in addition the coefficient of the regulation dummy *(dumreg2)* also appears to be significant (at the 10% level). Once more this implies that well-developed institutions and regulation do *not* benefit efficient operation of MFIs.

Table 14: Stochastic cost regression results: regulation dummy included

```
note: dumacoop dropped because of collinearity
note: dumcmiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    7491.16
Log likelihood = -171.70324                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   .9674156***.1749275     5.53   0.000      .624564    1.310267
       lnglp |   .9897129***.1057722     9.36   0.000     .7824032    1.197023
lninterest~p |   -.198193   .1617409    -1.23   0.220    -.5151994    .1188134
       var12 |  -.0285324** .0114404    -2.49   0.013    -.0509552   -.0061096
       var13 |   .0524595***.0189996     2.76   0.006     .0152208    .0896981
       var23 |  -.0194594** .0079587    -2.45   0.014    -.0350582   -.0038606
    dumabank |   .7310136***.0550551    13.28   0.000     .6231076    .8389196
 dumanonbank |   .5920628*** .047822    12.38   0.000     .4983334    .6857922
dumanonpro~t |   .6028131***.0575344    10.48   0.000     .4900477    .7155785
     dumarur |    .781212***.1916825     4.08   0.000     .4055212    1.156903
       _cons |   -6.73141   1.568527    -4.29   0.000    -9.805666   -3.657154
-------------+----------------------------------------------------------------
mu           |
     dumreg2 |   .2625119*  .1406413     1.87   0.062      -.01314    .5381639
Institutions |   .0819731***.0306787     2.67   0.008     .0218439    .1421023
         age |   .0096605   .0062189     1.55   0.120    -.0025283    .0218492
   dumbindiv |   .1979814    .125576     1.58   0.115    -.0481431    .4441058
     dumbsol |   .0240685   .1966482     0.12   0.903    -.3613548    .4094918
     dumbmix |  -.0111253   .1179557    -0.09   0.925    -.2423141    .2200635
    dumbvill |   .3197736   .2086872     1.53   0.125    -.0892457    .7287929
  dumcafrica |   -.484237***.1608788    -3.01   0.003    -.7995537   -.1689203
dumceastasia |   .0027954   .1580626     0.02   0.986    -.3070015    .3125923
   dumclatin |  -.8154088***.2413403    -3.38   0.001    -1.288427   -.3423904
       _cons |   .1777228   .2854682     0.62   0.534    -.3817845    .7372301
-------------+----------------------------------------------------------------
   /lnsigma2 |  -1.319969   .2346658    -5.62   0.000    -1.779905    -.860032
  /ilgtgamma |   1.748341   .3395101     5.15   0.000     1.082914    2.413769
-------------+----------------------------------------------------------------
      sigma2 |   .2671437   .0626895                      .1686541    .4231485
       gamma |   .8517434   .0428722                       .747045    .9178712
    sigma_u2 |   .2275379   .0597173                      .1104942    .3445816
    sigma_v2 |   .0396058   .0107664                      .0185041    .0607075
------------------------------------------------------------------------------
```

Notes: (1)dumreg2 is the dummy variable for regulated MFIs
(2)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(3)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(4)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

However, because the effect of institutions on inefficiency may change when the MFI is regulated, an interaction term where institutions (one factor) interact with the regulation dummy has been added (table 15). The results are again remarkable.

Table 15: Stochastic cost regression: interaction term included

```
note: dumabank dropped because of collinearity
note: dumcmiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                Wald chi2(10)   =    5127.96
Log likelihood = -129.50374                     Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.175505***.2023616     5.81   0.000      .778884    1.572127
       lnglp |   1.081477***.1193586     9.06   0.000     .8475382    1.315415
lninterest~p |    .178988   .1681372     1.06   0.287    -.1505548    .5085308
       var12 |  -.0417717***.0133036    -3.14   0.002    -.0678462   -.0156972
       var13 |   .0186927   .0189517     0.99   0.324     -.018452    .0558374
       var23 |  -.0255333***.0077074    -3.31   0.001    -.0406396    -.010427
    dumacoop |  -.6773272***.0650301   -10.42   0.000    -.8047837   -.5498706
 dumanonbank |   .0583055   .0754913     0.77   0.440    -.0896546    .2062657
dumanonpro~t |  -.0537842   .0788415    -0.68   0.495    -.2083107    .1007422
     dumarur |    .119142   .2057494     0.58   0.563    -.2841195    .5224034
       _cons |  -7.554116   1.759438    -4.29   0.000    -11.00255   -4.105681
-------------+----------------------------------------------------------------
mu           |
     dumreg2 |   .6928559** .3096841     2.24   0.025     .0858862    1.299826
Institutions |   .7270569***.2513806     2.89   0.004       .23436    1.219754
     instreg |  -.6465673***.2407226    -2.69   0.007    -1.118375   -.1747597
         age |   .0225335   .0115847     1.95   0.052    -.0001721    .0452391
   dumbindiv |  -.2025997   .2228385    -0.91   0.363    -.6393551    .2341556
     dumbsol |  -.1091317   .2194146    -0.50   0.619    -.5391764     .320913
     dumbmix |  -.0636922   .1232744    -0.52   0.605    -.3053057    .1779212
    dumbvill |  -.0397348   .2400283    -0.17   0.869    -.5101816    .4307121
  dumcafrica |  -.6026773***.1913888    -3.15   0.002    -.9777924   -.2275622
dumceastasia |  -.0626086   .1709024    -0.37   0.714    -.3975713     .272354
   dumclatin |  -.4658493**  .208638    -2.23   0.026    -.8747723   -.0569262
       _cons |  -.3254651   .5081787    -0.64   0.522    -1.321477    .6705469
-------------+----------------------------------------------------------------
   /lnsigma2 |  -1.360842    .218846    -6.22   0.000    -1.789772   -.9319118
  /ilgtgamma |   1.577571    .365095     4.32   0.000     .8619981    2.293144
-------------+----------------------------------------------------------------
      sigma2 |   .2564447   .0561219                      .1669982    .3938001
       gamma |   .8288603   .0517891                      .7030779    .9083077
    sigma_u2 |   .2125568   .0554318                      .1039125    .3212012
    sigma_v2 |   .0438879   .0108353                      .0226511    .0651246
------------------------------------------------------------------------------
```

Notes: (1)instreg(=dumreg2*Institutions) is the interaction term that accounts for interaction between institutions and MFI regulation
(2)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(3)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(4)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

The interaction term *instreg (dumreg2*Institutions)* that allows for interaction between institutions and regulated MFIs has a negative and highly significant coefficient. This indicates that if a MFI is regulated, well-developed institutions induce the MFI to perform less *inefficient* or more *efficient.* In contrast, if the MFI is not regulated, well-developed

institutions make the MFI perform more *inefficient* or less *efficient.* [9] In addition, *Institutions* and *dumreg2* both appear to have a positive effect on inefficiency, which is highly significant. This again indicates the damage that well-developed institutions and regulation can do to MFI performance.

Overall, the estimation results suggest that not only institutions and regulation by itself affect the performance of MFIs, but that the effect of institutions on performance also depends on whether the MFI is regulated or not.

Finally, the estimate of the variance parameter, γ (gamma), is close to one (approximately 0,83), indicating that the inefficiency effects are likely to be highly significant. With respect to the generalized likelihood ratio test, all performed estimates show to be highly significant (prob>chi-squared=0.000). This implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.

Some Robustness Tests

Since estimation results may be different depending on which control variables are used in the regression equation, a couple of tests with other control variables are conducted.

Changing a cost frontier variable

To see if results are different when changing the control variables of the cost frontier a similar stochastic model is estimated where loan loss reserve is added to the cost frontier.

Loan loss reserve represents the outstanding loan portfolio that is not expected to be recovered. Since MFIs have to deal with a substantial amount of risk of clients that do not repay their loans, this variable can be taken into account when measuring total costs. However, adding loan loss reserve to the cost frontier leads to a high correlation between *(ln) loan loss reserve* and *(ln) gross loan portfolio* (see table 16 for correlation matrix). Therefore, including both variables in the cost frontier will not yield reliable results.

Table 16: Correlation matrix cost frontier variables

	lnsalary	lnglp	lninte~p	lnloan~s
lnsalary	1.0000			
lnglp	0.6208	1.0000		
lninterest~p	-0.2771	-0.2496	1.0000	
lnloanloss~s	0.6504	0.9234	-0.2381	1.0000

[9] See appendix 4 table 2 for estimation results when dummy for unregulated MFIs is included. As expected the results show opposites signs.

When Gross Loan Portfolio is left out of analysis, the estimation results show a positive significant coefficient for *(ln) Loan Loss Reserve* and more importantly, equal significant signs for the coefficients for the variables in question: *institutions* and the interaction term *instreg* (institutions and the dummy for regulated MFIs). The effects on inefficiency thus do not change much after changing this control variable (see table 17)

Table 17: Stochastic cost regression: Gross Loan Portfolio replaced by Loan Loss Reserve

```
Stoc. frontier normal/truncated-normal model
                                                Wald chi2(11)   =   48849.71
Log likelihood =  -324.2669                     Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   .4769575** .1839277     2.59   0.010     .1164657    .8374492
lninterest~p |  -.5828563***.1897438    -3.07   0.002    -.9547473   -.2109653
       var13 |   .0970765***.0229925     4.22   0.000     .0520121    .1421409
lnloanloss~s |   .4453587***.1439191     3.09   0.002     .1632826    .7274349
       var14 |   .0111402   .0154978     0.72   0.472    -.0192349    .0415153
       var34 |  -.0267426*** .009038    -2.96   0.003    -.0444568   -.0090285
     dumbank |   3.160154*  1.653343     1.91   0.056    -.0803399    6.400647
     dumcoop |   2.275558   1.665039     1.37   0.172    -.9878593    5.538975
  dumnonbank |   2.820003*  1.657523     1.70   0.089    -.4286824    6.068689
 dumnonpro~t |    2.84452*  1.656487     1.72   0.086    -.4021339    6.091174
     dumarur |    2.89843*  1.685036     1.72   0.085      -.40418     6.20104
-------------+----------------------------------------------------------------
mu           |
institutions |   .2755153***.1048029     2.63   0.009     .0701054    .4809251
         age |    .010441   .0068477     1.52   0.127    -.0029802    .0238622
    dumindiv |   .1044342   .1343865     0.78   0.437    -.1589585    .3678268
      dumsol |   .4557876** .1916083     2.38   0.017     .0802422     .831333
      dummix |   .1911841   .1198099     1.60   0.111    -.0436389    .4260071
     dumvill |   .5752901** .2487293     2.31   0.021     .0877897    1.062791
    dumlatin |  -.8172783***.1955922    -4.18   0.000    -1.200632   -.4339246
     dumreg2 |   .0809958   .1454184     0.56   0.578    -.2040191    .3660107
     instreg |  -.2233937** .1019967    -2.19   0.029    -.4233036   -.0234837
       _cons |   .4955633   .2808935     1.76   0.078    -.0549778    1.046104
-------------+----------------------------------------------------------------
   /lnsigma2 |  -.8898381   .1561767    -5.70   0.000    -1.195939   -.5837374
  /ilgtgamma |   1.544507   .3668594     4.21   0.000     .8254753    2.263538
-------------+----------------------------------------------------------------
      sigma2 |   .4107222   .0641452                      .3024199    .5578097
       gamma |   .8241189   .0531752                      .6953974    .9058119
    sigma_u2 |   .3384839   .0638506                       .213339    .4636288
    sigma_v2 |   .0722383   .0207941                      .0314825     .112994
------------------------------------------------------------------------------
```

Notes: (1)Loan Loss Reserve replaces GLP
(2)var14=lnsalary*lnloanlossreserve and var 34=lninterestexp*lnloanlossreserve
(3)instreg(=dumreg2*Institutions) is the interaction term that accounts for interaction between institutions and MFI regulation
(4)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(5)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(6)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Changing variables in the efficiency equation

Replacing the variable *AGE* for the number of borrowers to which the MFI provides loans does not alter the significance of the variables. All discussed variables remain significant, implying that developed institutions improve the efficient performance of the MFI only if the MFI is regulated (see table 18).

Table 18: Stochastic cost regression: *age* replaced by number of borrowers

```
note: dumacoop dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    1450.65
Log likelihood = -148.83141                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.005063***.1889167     5.32   0.000     .6347927    1.375333
lninterest~p |  -.0529843   .1491561    -0.36   0.722    -.3453249    .2393563
       lnglp |   .8506647***.1113976     7.64   0.000     .6323294       1.069
       var12 |  -.0274094** .0117883    -2.33   0.020     -.050514   -.0043048
       var13 |   .0236796   .0186278     1.27   0.204    -.0128302    .0601893
       var23 |  -.0112228   .0101682    -1.10   0.270    -.0311522    .0087066
     dumbank |   .5669156***.0624421     9.08   0.000     .4445313       .6893
  dumnonbank |   .4339525***.0561577     7.73   0.000     .3238854    .5440196
 dumnonpro~t |   .4659157***.0591305     7.88   0.000     .3500222    .5818093
      dumrur |    .224483   .1795712     1.25   0.211    -.1274701    .5764361
       _cons |  -5.197118   1.727305    -3.01   0.003    -8.582573   -1.811663
-------------+----------------------------------------------------------------
mu           |
institutions |   .1722501***.0497996     3.46   0.001     .0746447    .2698555
     dumreg2 |   .1410108** .0661064     2.13   0.033     .0114446    .2705771
     instreg |  -.1570976***.0501977    -3.13   0.002    -.2554833   -.0587118
       lnbor |   .2090932***.0322986     6.47   0.000      .145789    .2723973
   dumafrica |  -.3276986***.0894975    -3.66   0.000    -.5031103   -.1522868
 dumeastasia |  -.1423575   .0915432    -1.56   0.120    -.3217788    .0370638
 dumeaster~u |   .0105216   .1242811     0.08   0.933     -.233065    .2541082
    dumlatin |  -.3209946***.1153294    -2.78   0.005     -.547036   -.0949532
    dumindiv |   .0644686   .0519956     1.24   0.215     -.037441    .1663781
      dumsol |  -.1563156   .1120161    -1.40   0.163    -.3758632     .063232
      dummix |  -.0634514    .053126    -1.19   0.232    -.1675765    .0406736
     dumvill |  -.0026034   .1257588    -0.02   0.983    -.2490861    .2438794
       _cons |  -1.201503   .3808858    -3.15   0.002    -1.948026    -.454981
-------------+----------------------------------------------------------------
   /lnsigma2 |  -2.065811   .0897207   -23.02   0.000    -2.241661   -1.889962
  /ilgtgamma |   1.115296    .952003     1.17   0.241     -.750596    2.981187
-------------+----------------------------------------------------------------
      sigma2 |   .1267154    .011369                      .1062819    .1510775
       gamma |   .7531151   .1770086                      .3206915     .951717
    sigma_u2 |   .0954313    .025975                      .0445212    .1463414
    sigma_v2 |   .0312841   .0218803                     -.0116004    .0741687
------------------------------------------------------------------------------
```

Notes: (1)lnbor= the log of the numbers of borrowers the MFI provides loans to
(2)instreg(=dumreg2*Institutions) is the interaction term that accounts for interaction between institutions and MFI regulation
(3)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(4)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(5)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Since MFIs located in Latin America represent almost 50% of the sample, the results may be biased towards this region and it is interesting to estimate the regression without the region dummies. The estimation results are shown in table 19.

Table 19: Stochastic cost regression: region dummies excluded

```
Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    7354.49
Log likelihood = -178.34681                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.113046***.1802882     6.17   0.000     .7596876    1.466404
       lnglp |   1.145429***.1055801    10.85   0.000     .9384962    1.352363
lninterest~p |   .0887497   .1496454     0.59   0.553      -.20455    .3820493
       var12 |  -.0454476***.0116109    -3.91   0.000    -.0682046   -.0226906
       var13 |   .0165968   .0157022     1.06   0.291    -.0141789    .0473726
       var23 |  -.0163728** .0075947    -2.16   0.031    -.0312581   -.0014874
     dumbank |   .7426429*** .059661    12.45   0.000     .6257095    .8595763
  dumnonbank |   .5682896***.0489025    11.62   0.000     .4724424    .6641368
 dumnonpro~t |   .6045917***.0605273     9.99   0.000     .4859604     .723223
      dumrur |   .6535955***.1517705     4.31   0.000     .3561307    .9510602
       _cons |   -7.96089   1.604414    -4.96   0.000    -11.10548   -4.816296
-------------+----------------------------------------------------------------
mu           |
institutions |   .7257075   .5013943     1.45   0.148    -.2570073    1.708422
     dumreg2 |   .7288584    .572133     1.27   0.203    -.3925016    1.850218
     instreg |  -.6322113    .453353    -1.39   0.163    -1.520767    .2563442
         age |   .0088198   .0098949     0.89   0.373    -.0105739    .0282136
    dumindiv |   .1787144   .1891289     0.94   0.345    -.1919714    .5494002
      dumsol |  -.0236792   .4082556    -0.06   0.954    -.8238454    .7764871
      dummix |   .1099634   .1924023     0.57   0.568    -.2671382     .487065
     dumvill |   .5684706   .4069208     1.40   0.162    -.2290795    1.366021
       _cons |  -1.244127   1.345552    -0.92   0.355     -3.88136    1.393106
-------------+----------------------------------------------------------------
   /lnsigma2 |  -.9388084   .5240244    -1.79   0.073    -1.965877    .0882606
  /ilgtgamma |   1.801265   .5077105     3.55   0.000     .8061703    2.796359
-------------+----------------------------------------------------------------
      sigma2 |   .3910936   .2049426                      .140033    1.092273
       gamma |   .8583028   .0617473                     .6912928    .9424788
    sigma_u2 |   .3356767   .1976754                    -.0517599    .7231134
    sigma_v2 |   .0554169   .0134147                     .0291245    .0817092
------------------------------------------------------------------------------
```

Notes: (1)instreg(=dumreg2*Institutions) is the interaction term that accounts for interaction between institutions and MFI regulation
(2)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(3)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(4)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Without the region dummies the variables of the inefficiency equation are no longer significant. Moreover, adding the region dummy for Latin America to the inefficiency equation is enough to make the results significant again, while results are not significant if this is the only region dummy left out of analysis.[10] Since Latin America comprises almost 50% of the MFIs in the sample, this may be an explanation for the different results. However,

[10] See appendix 6 and 7, table 4 and 5

if gross loan portfolio is replaced by loan loss reserve the results remain significant even if none of the region dummies is included (see table 20).

Table 20: Stochastic cost regression: GLP replaced by Loan Loss Reserve

```
note: dumacoop dropped because of collinearity
note: dumcmiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    2640.40
Log likelihood = -341.21152                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   .7253136***.1859008     3.90   0.000     .3609547    1.089673
lninterest~p |  -.3990439** .1900205    -2.10   0.036    -.7714773   -.0266105
lnloanloss~s |   .6764199***.1439781     4.70   0.000      .394228    .9586118
       var13 |   .0740323***.0223099     3.32   0.001     .0303058    .1177589
       var14 |  -.0168077   .0155241    -1.08   0.279    -.0472345     .013619
       var34 |  -.0261934***.0088791    -2.95   0.003    -.0435961   -.0087907
     dumbank |   .8922474***.0864418    10.32   0.000     .7228246     1.06167
  dumnonbank |   .5058361***.0750618     6.74   0.000     .3587176    .6529546
 dumnonpro~t |   .6185791***.0835179     7.41   0.000     .4548871    .7822711
      dumrur |   .6283525*** .229143     2.74   0.006     .1792405    1.077465
       _cons |   .3128594   1.680188     0.19   0.852    -2.980249    3.605968
-------------+----------------------------------------------------------------
mu           |
institutions |   .3027439** .1205665     2.51   0.012     .0664379    .5390499
     dumreg2 |   .3426452** .1534694     2.23   0.026     .0418508    .6434396
     instreg |  -.2605107** .1176532    -2.21   0.027    -.4911067   -.0299148
         age |   .0089234   .0062211     1.43   0.151    -.0032698    .0211165
    dumindiv |   .1399239   .1263746     1.11   0.268    -.1077659    .3876136
      dumsol |   .7242179***.2325308     3.11   0.002     .2684659     1.17997
     dumvill |   .9364812*** .274858     3.41   0.001     .3977695    1.475193
      dummix |   .4007484***.1346029     2.98   0.003     .1369316    .6645652
       _cons |  -.0988503   .3854819    -0.26   0.798    -.8543809    .6566803
-------------+----------------------------------------------------------------
   /lnsigma2 |   -.875223   .1952081    -4.48   0.000    -1.257824   -.4926221
  /ilgtgamma |   1.454906    .372263     3.91   0.000     .7252844    2.184528
-------------+----------------------------------------------------------------
      sigma2 |   .4167691   .0813567                      .284272    .6110221
       gamma |   .8107524   .0571174                     .6737696    .8988515
    sigma_u2 |   .3378965   .0791717                     .1827229    .4930702
    sigma_v2 |   .0788726   .0221004                     .0355566    .1221885
```

Notes: (1) Loan Loss reserve is added, while glp is omitted
(2) var14=lnsalary*lnloanlossreserve; var34=lninterestexp*loanlossreserve
(3)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(4)instnonreg(=dumreg1*Institutions) is the interaction term that accounts for interaction between institutions and unregulated MFIss
(5)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(6)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Moreover, it seems likely that the results can be applied to MFIs located in the region Latin America but it is less reliable to generalize them to the other regions yet. Further investigation with larger sample sizes of the other regions should point this out.

7. Discussion and Conclusion

The estimation results implicate that MFIs perform better if institutional quality is low. Besides, performance is also higher if the MFI is not regulated.

These results contradict the believe that well-developed institutions and regulation of MFIs are the fundaments of good performance, but seem to be in accordance with the argument that MFIs can only flourish in countries with weak environments because they do not have to rely on the expensive rules and regulation. They need flexible regulatory frameworks to serve the needs of their customers. MFIs have different principles than more traditional financial institutions and require other environmental settings to achieve operational efficiency.

However, if the two factors (institutions and regulation) become interdependent, poorly developed institutions are no longer beneficial for MFI performance. Once the MFI is regulated, better performance requires a well-developed institutional environment as well. In contrast, if the MFI is not regulated it cannot operate in accordance with well-developed institutions and therefore performs better if institutional quality is low.

In sum, the estimation results of this study show that (1) MFIs perform better in countries with *poorly* developed institutions, (2) that unregulated MFIs perform better than regulated MFIs, but (3) that well-developed institutions can be good for MFI performance on condition that the MFI is regulated.

Although most evidence tries to proof otherwise, these results seem plausible since MFI are built and developed to function in developing countries where institutional settings are principally weak. Above all, a regulated and organised firm most probably requires a well-organised and -developed institutional environment as well. Regulation of MFIs and well-developed institutions are not mutually exclusive, instead they have to be present at the same time.

8. Recommendations

The evidence of this study rejects the belief in high institutional quality and regulation for an efficient performance of MFIs and supports the controversial view of the harmful effects that institutional quality may have on the performance of microfinance institutions.

The striking results of this research show that institutional quality may not always be good and even be bad for the performance of microfinance institutions. This finding challenges the greatest stream of literature, which suggests that institutional quality is fundamental for financial development. The lesson to be learned here is that MFIs should not unthinkingly trust and base its operational decisions on the generally accepted view that developed institutions benefit the performance of financial institutions.

This paper also pinpoints the importance of interdependence between the institutional environment and financial regulation and their effect on MFI performance. It suggests that in the decision to become regulated, the MFI should seriously consider the quality of the institutional settings of a country because the increasing tendency toward becoming regulated might not be necessary at all.

However, the results should be interpreted with some caution. Almost half of the MFIs used in the sample are located in *Latin America.* Although it seems likely that the results apply to this region they cannot yet be generalized to the other regions. Further research is suggested, where the remaining regions used in the sample are better represented. Besides, although this study experiments with the inclusion of other control variables, this experimentation should be extended to make results more robust and applicable.

Because this study focuses in particular on the overall effect of institutional settings on MFI performance, more research to the individual impacts of the different institutional indicators on performance is suggested.

In addition, because of the minor focus on ownership differences in this study, more extensive research in this field is recommended. Because regulation also depends on MFI type, non-profit MFIs (mostly non- or self-regulated) will probably gain from little restrictions and high freedom, whereas commercial MFIs (mostly supervised by bank authority) will probably loose from little rules and regulation.

Furthermore, because MFIs are principally located in developing countries, most available data comes from MFIs located in these countries. However, MFIs do also exist in developed

countries. It would be interesting to investigate what impact institutional quality has on MFI performance in these countries.

Finally, instead of the Kaufmann indicators more financial indicators could be studied. MFI performance may be even more affected by financial indicators that are particularly aimed at financial institutions.

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Appendix

A1. List of definitions

Allocative inefficiency: A firm's success in choosing an optimal set of inputs

Efficiency: Refers to how well firms are performing relative to the existing technology in the industry

Institutions (institutional variables): The six governance indicators that determine a countries institutional settings; Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption

Institutional quality: The structural components of a society through which its main concerns and activities are organised, for example, the church, the law, government, family

Micro Finance Institutions (MFI): Organisations that provide financial services to poor or low-income clients

Productivity: The evolution of technology over time

Regulation (=Financial regulation): Form of supervision that subjects financial institutions to certain requirements, restrictions and guidelines; or the state of being controlled or governed

Regulatory Quality: Measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development

Stochastic frontier analysis (SFA): A method of economic modelling and tool for production/cost/profit analysis

Technology: Described by a production function, which represents the relationship of an output to inputs in the production process

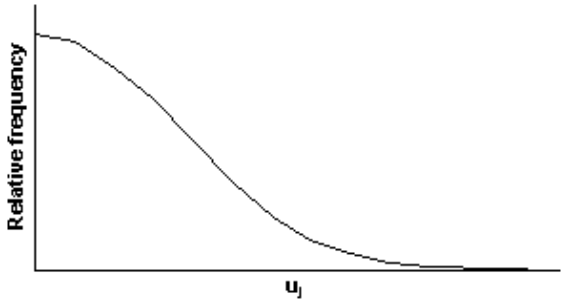
Technical inefficiency: A firm's success in producing maximum output from a given set of inputs

Total factor productivity (TFP): A measure of the economic efficiency of a firm's operations, defined as the ratio of output to inputs

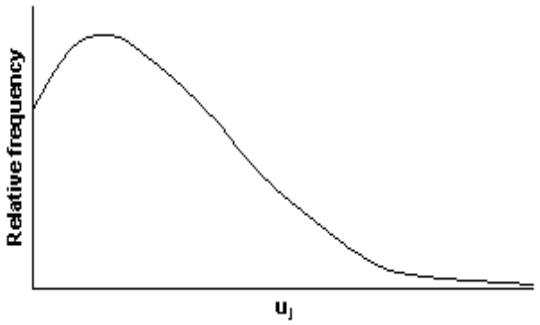
X-efficiency: Technical efficiency and Allocative inefficiency

***A2*. Figure 1:** Various distributions of the inefficiency term

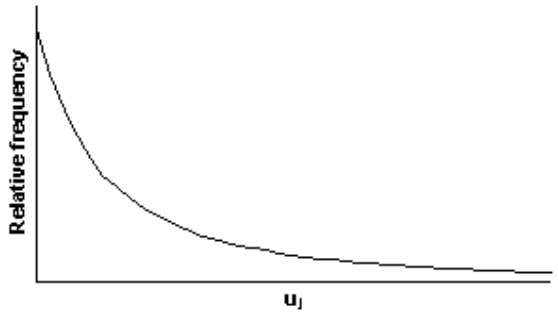
A) Half-normal



B) Truncated



C) Exponential



A3. **Table 1:** Stochastic Cost Regression: Polynomial Model of 2nd Degree

```
note: sqrvar3 dropped because of collinearity
note: dumabank dropped because of collinearity
note: dumcmiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                Wald chi2(12)   =    7240.04
Log likelihood = -162.57109                     Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.208949***.3923947     3.08   0.002     .4398699    1.978029
       lnglp |   .7456876***.1701206     4.38   0.000     .4122575    1.079118
lninterest~p |   -.258654   .1583324    -1.63   0.102    -.5689799    .0516718
     sqrvar1 |   .0073325   .0233846     0.31   0.754    -.0385005    .0531655
     sqrvar2 |   .0151588** .0071545     2.12   0.034     .0011362    .0291814
       var12 |   -.052559***.0159473    -3.30   0.001    -.0838151   -.0213029
       var13 |   .0392785** .0193675     2.03   0.043     .0013189    .0772381
       var23 |  -.0076244   .0094225    -0.81   0.418    -.0260922    .0108435
    dumabank |  -.0357942   .2026967    -0.18   0.860    -.4330724     .361484
dumanonpro~t |  -.1366921   .2019228    -0.68   0.498    -.5324535    .2590693
 dumanonbank |  -.1457133   .2022705    -0.72   0.471    -.5421563    .2507297
    dumacoop |  -.7134851***.2048677    -3.48   0.000    -1.115019   -.3119518
       _cons |  -5.293472   1.918714    -2.76   0.006    -9.054082   -1.532863
-------------+----------------------------------------------------------------
mu           |
     dumreg2 |   .3325379   .1771343     1.88   0.060    -.0146389    .6797148
         age |    .007794   .0058378     1.34   0.182     -.003648    .0192359
Institutions |   .4152653** .1623447     2.56   0.011     .0970754    .7334552
     instreg |  -.3553175** .1489752    -2.39   0.017    -.6473036   -.0633314
   dumbindiv |   .2084638   .1122517     1.86   0.063    -.0115456    .4284731
     dumbsol |  -.0449088   .1876338    -0.24   0.811    -.4126642    .3228466
     dumbmix |   .0266511   .1034051     0.26   0.797    -.1760192    .2293214
    dumbvill |   .1072242   .2013034     0.53   0.594    -.2873232    .5017716
  dumcafrica |  -.4310805***.1422711    -3.03   0.002    -.7099268   -.1522343
   dumclatin |  -.7365021***.2078119    -3.54   0.000    -1.143806   -.3291983
dumceastasia |   -.012344   .1512412    -0.08   0.935    -.3087713    .2840834
       _cons |   .1761678   .3290765     0.54   0.592    -.4688102    .8211458
-------------+----------------------------------------------------------------
   /lnsigma2 |   -1.44607   .2113842    -6.84   0.000    -1.860376   -1.031765
  /ilgtgamma |   1.645011    .358796     4.58   0.000     .9417835    2.348238
-------------+----------------------------------------------------------------
      sigma2 |   .2354939   .0497797                      .1556142    .3563774
       gamma |   .8382156   .0486564                      .7194598    .9127941
    sigma_u2 |   .1973947   .0468218                      .1056256    .2891638
    sigma_v2 |   .0380992   .0115933                      .0153768    .0608216
```

Notes: (1)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(2)dumreg2 is the regulation dummy
(3)instreg(=dumreg2*Institutions) is the interaction term that accounts for interaction between institutions and MFI regulation
(4)sqrvar1=lnsalary^2, sqrvar2=lnglp^2, sqrvar3=lninterestexpense^2 are the quadratic terms. Only sqrvar2 turns out to be significant.
(5)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(6)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

A4. **Table 2:** Stochastic Cost Regression: dummy for unregulated MFIs included

```
note: dumbank dropped because of collinearity
note: dummiddleeast dropped because of collinearity

Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    5127.97
Log likelihood = -129.50374                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.175506***.2023616     5.81   0.000     .7788842    1.572127
       lnglp |   1.081477***.1193586     9.06   0.000     .8475382    1.315415
lninterest~p |   .1789881   .1681373     1.06   0.287    -.1505548    .5085311
       var12 |  -.0417717***.0133036    -3.14   0.002    -.0678462   -.0156972
       var13 |   .0186927   .0189517     0.99   0.324     -.018452    .0558374
       var23 |  -.0255333***.0077074    -3.31   0.001    -.0406396    -.010427
    dumcoop  |  -.6773273***  .06503   -10.42   0.000    -.8047839   -.5498708
 dumnonbank  |   .0583055   .0754913     0.77   0.440    -.0896547    .2062656
dumnonpro~t  |  -.0537845   .0788415    -0.68   0.495    -.2083109    .1007419
     dumrur  |   .1191425   .2057493     0.58   0.563    -.2841187    .5224037
       _cons |  -7.554117   1.759438    -4.29   0.000    -11.00255   -4.105681
-------------+----------------------------------------------------------------
mu           |
Institutions |   .0804898***.0291623     2.76   0.006     .0233328    .1376469
     dumreg1 |  -.6928583** .3096852    -2.24   0.025     -1.29983   -.0858865
  instnonreg |   .6465694***.2407233     2.69   0.007     .1747603    1.118379
         age |   .0225336   .0115847     1.95   0.052    -.0001721    .0452393
   dumindiv  |  -.2026006   .2228392    -0.91   0.363    -.6393575    .2341562
     dumsol  |  -.1091318   .2194153    -0.50   0.619    -.5391779    .3209143
     dummix  |  -.0636923   .1232748    -0.52   0.605    -.3053065    .1779219
    dumvill  |   -.039735    .240029    -0.17   0.869    -.5101832    .4307132
  dumafrica  |  -.6026789***.1913893    -3.15   0.002    -.9777951   -.2275628
dumeastasia  |  -.0626084   .1709029    -0.37   0.714     -.397572    .2723551
   dumlatin  |  -.4658505** .2086386    -2.23   0.026    -.8747746   -.0569264
       _cons |   .3673886   .2592302     1.42   0.156    -.1406932    .8754705
-------------+----------------------------------------------------------------
   /lnsigma2 |  -1.360839   .2188458    -6.22   0.000    -1.789769    -.931909
  /ilgtgamma |   1.577575   .3650942     4.32   0.000     .8620032    2.293146
-------------+----------------------------------------------------------------
      sigma2 |   .2564456    .056122                      .1669988    .3938012
       gamma |   .8288608   .0517888                       .703079    .9083078
    sigma_u2 |   .2125577   .0554319                      .1039131    .3212022
    sigma_v2 |   .0438879   .0108353                      .0226512    .0651246
------------------------------------------------------------------------------
```

Notes: (1)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(2)dumreg1 is the dummy for unregulated MFIs
(3)instnonreg(=dumreg1*Institutions) is the interaction term that accounts for interaction between institutions and unregulated MFIss
(4)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(5)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

A5. **Table 3:** Number of MFIs per country

Country	Freq.	Percent	Cum.
Albania	15	0.89	0.89
Argentina	4	0.24	1.13
Armenia	13	0.77	1.90
Azerbaijan	34	2.01	3.91
Bangladesh	33	1.95	5.86
Benin	32	1.90	7.76
Bolivia	106	6.28	14.04
Bosnia and Herzegovina	80	4.74	18.78
Brazil	17	1.01	19.79
Bulgaria	11	0.65	20.44
Burkina Faso	6	0.36	20.79
Cambodia	59	3.50	24.29
Cameroon	11	0.65	24.94
Chile	7	0.41	25.36
Colombia	49	2.90	28.26
Dominican Republic	17	1.01	29.27
East Timor	3	0.18	29.44
Ecuador	121	7.17	36.61
Egypt	26	1.54	38.15
El Salvador	15	0.89	39.04
Ethiopia	35	2.07	41.11
Georgia	25	1.48	42.59
Ghana	12	0.71	43.31
Ghane	1	0.06	43.36
Guatemala	14	0.83	44.19
Guinea	7	0.41	44.61
Haiti	15	0.89	45.50
Honduras	15	0.89	46.39
India	96	5.69	52.07
Indonesia	5	0.30	52.37
Jordan	19	1.13	53.50
Kazakhstan	7	0.41	53.91
Kenya	35	2.07	55.98
Kosovo	20	1.18	57.17
Kyrgyzstan	22	1.30	58.47
Mali	21	1.24	59.72
Mexico	41	2.43	62.14
Moldova	4	0.24	62.38
Mongolia	17	1.01	63.39
Morocco	47	2.78	66.17
Mozambique	7	0.41	66.59
Nepal	32	1.90	68.48
Nicaragua	86	5.09	73.58
Nigeria	7	0.41	73.99
Pakistan	21	1.24	75.24
Palestine	19	1.13	76.36
Paraguay	23	1.36	77.73
Peru	163	9.66	87.38
Philippines	26	1.54	88.92
Russia	22	1.30	90.23
Senegal	22	1.30	91.53
Serbia and Montenegro	14	0.83	92.36
South Africa	22	1.30	93.66
Tajikistan	14	0.83	94.49
Tanzania	25	1.48	95.97
Togo	10	0.59	96.56
Trinidad And Tobago	2	0.12	96.68
Uganada	10	0.59	97.27
Uganda	29	1.72	98.99
Uruguay	3	0.18	99.17
Venezuela	5	0.30	99.47
Vietnam	9	0.53	100.00
Total	1,688	100.00	

A6. **Table 4:** Stochastic Cost Regression: region dummy *Latin America* included

```
Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(10)   =    7323.75
Log likelihood = -171.99989                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   .9726318***.1771818     5.49   0.000     .6253618    1.319902
       lnglp |   1.046717***.1054797     9.92   0.000     .8399801    1.253453
lninterest~p |   -.035227   .1501697    -0.23   0.815    -.3295541    .2591001
       var12 |  -.0335284***.0115932    -2.89   0.004    -.0562508   -.0108061
       var13 |   .0287875*  .0160715     1.79   0.073    -.0027121     .060287
       var23 |  -.0149133*  .0077022    -1.94   0.053    -.0300093    .0001827
     dumbank |   .7411582***.0568915    13.03   0.000     .6296529    .8526634
  dumnonbank |   .5969365***.0476958    12.52   0.000     .5034544    .6904186
 dumnonpro~t |   .5931304***.0589066    10.07   0.000     .4776756    .7085852
     dumarur |   .6922578***.1597261     4.33   0.000     .3792004    1.005315
       _cons |  -6.869953   1.578288    -4.35   0.000     -9.96334   -3.776565
-------------+----------------------------------------------------------------
mu           |
institutions |   .5444892**  .246663     2.21   0.027     .0610387     1.02794
     dumreg2 |   .3415843   .2502815     1.36   0.172    -.1489584     .832127
     instreg |  -.4522002** .2231294    -2.03   0.043    -.8895257   -.0148746
         age |   .0095145   .0080377     1.18   0.237     -.006239    .0252681
    dumindiv |   .1301635   .1529862     0.85   0.395     -.169684    .4300109
      dumsol |  -.1605061   .2924918    -0.55   0.583    -.7337795    .4127673
      dummix |  -.0799487   .1580409    -0.51   0.613    -.3897031    .2298057
     dumvill |   .1512071   .2669364     0.57   0.571    -.3719786    .6743928
    dumlatin |  -.6049891**  .257234    -2.35   0.019    -1.109158   -.1008198
       _cons |  -.3280825   .5102152    -0.64   0.520    -1.328086     .671921
-------------+----------------------------------------------------------------
   /lnsigma2 |   -1.12065   .3092976    -3.62   0.000    -1.726862   -.5144382
  /ilgtgamma |     1.7482   .3684986     4.74   0.000     1.025956    2.470444
-------------+----------------------------------------------------------------
      sigma2 |   .3260677   .1008519                      .1778415    .5978363
       gamma |   .8517256   .0465374                      .7361311    .9220437
    sigma_u2 |   .2777202   .0980845                       .085478    .4699623
    sigma_v2 |   .0483475   .0101805                       .028394     .068301
------------------------------------------------------------------------------
```

Notes: (1)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(2)instnonreg(=dumreg1*Institutions) is the interaction term that accounts for interaction between institutions and unregulated MFIss
(3)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(4)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

A7. **Table 5:** Stochastic Cost Regression: region dummy for *Latin America* left out

```
Stoc. frontier normal/truncated-normal model
                                                  Wald chi2(11)   =   75717.17
Log likelihood = -175.05702                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lntotalcost  |
    lnsalary |   1.068178***.1851736     5.77   0.000     .7052449    1.431112
lninterest~p |   .0387047   .1508861     0.26   0.798    -.2570266    .3344361
       lnglp |   1.109661***.1070571    10.37   0.000      .899833    1.319489
       var12 |  -.0417168***.0118326    -3.53   0.000    -.0649084   -.0185252
       var13 |   .0220226   .0161073     1.37   0.172    -.0095471    .0535924
       var23 |  -.0168158** .0075519    -2.23   0.026    -.0316173   -.0020143
     dumbank |  -6.803022***1.626029    -4.18   0.000     -9.98998   -3.616063
     dumcoop |  -7.536015***1.638207    -4.60   0.000    -10.74684   -4.325188
  dumnonbank |  -6.977511***1.633314    -4.27   0.000    -10.17875   -3.776274
 dumnonpro~t |  -6.926693*** 1.63662    -4.23   0.000    -10.13441   -3.718976
     dumarur |  -6.831466***1.643296    -4.16   0.000    -10.05227   -3.610666
-------------+----------------------------------------------------------------
mu           |
institutions |   .7487186   .4556653     1.64   0.100     -.144369    1.641806
         age |    .010519   .0093075     1.13   0.258    -.0077233    .0287614
    dumindiv |   .2278636   .1857354     1.23   0.220     -.136171    .5918982
      dumsol |  -.0060454   .3846329    -0.02   0.987     -.759912    .7478213
      dummix |   .0845614   .1958017     0.43   0.666     -.299203    .4683257
     dumvill |   .6198482*  .3717681     1.67   0.095    -.1088038      1.3485
   dumafrica |   -.022094   .1989686    -0.11   0.912    -.4120652    .3678773
 dumeastasia |   .5813386   .4161887     1.40   0.162    -.2343763    1.397053
 dumeaster~u |   .3764854    .327706     1.15   0.251    -.2658065    1.018777
     dumreg2 |   .7925482   .5174547     1.53   0.126    -.2216444    1.806741
     instreg |  -.6548719   .4131223    -1.59   0.113    -1.464577     .154833
       _cons |  -1.330633   1.188364    -1.12   0.263    -3.659783    .9985182
-------------+----------------------------------------------------------------
   /lnsigma2 |  -1.005327   .4486952    -2.24   0.025    -1.884753   -.1259003
  /ilgtgamma |   1.736646   .4625334     3.75   0.000     .8300968    2.643194
-------------+----------------------------------------------------------------
      sigma2 |   .3659251   .1641888                      .1518666    .8817028
       gamma |   .8502605   .0588886                      .6963754    .9335903
    sigma_u2 |   .3111316   .1586806                      .0001233      .62214
    sigma_v2 |   .0547934   .0121831                       .030915    .0786719
```

Notes: (1)Institutions refers to the factor (computed by pca) that explains for 62.02% of the variance of the six institutional indicators.
(2)instnonreg(=dumreg1*Institutions) is the interaction term that accounts for interaction between institutions and unregulated MFIss
(3)gamma (γ), is close to one, indicating that the inefficiency effects are likely to be highly significant.
(4)prob>chi-squared=0.000, which implies that the null-hypotheses should be accepted and inefficiencies are present in all regression analyses.
*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level