# Analysis of the Cost-Efficiency of Microfinance Institutions in the West African Economic Monetary Union Area

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# Contents

# List of tables

# Abstract

The cost-efficiency of microfinance institutions (MFIs) has emerged as an issue crucial to their survival and the continuity of their services. The present study uses the stochastic frontier method to analyse the levels and determinants of cost-efficiency of a sample of microfinance institutions operating from the West African Economic and Monetary Union (WAEMU) area. For the 2000–2008 period, these MFIs were found to have functioned in an ineffective way in terms of minimizing their costs. Factors influencing cost-efficiency include the age and type of MFI. The study's results also reveal that the number of female borrowers, the MFI's financial performance, level of capitalization, geographical location, and size were explanatory factors for the cost-efficiency of the MFIs studied.



**Key Words:** *Cost-efficiency; Microfinance; Stochastic frontier; WAEMU*

# 1. Introduction

In order to facilitate the financing of rural areas within the WAEMU (a region with many disadvantaged populations) following the bankruptcy of state banks during the banking crisis, in 1989 the governments in the region explored various sources of financing with a view to diversifying the banking landscape. In particular, they had recourse to microcredit schemes. However, microcredit loans to the most disadvantaged populations give rise to high costs, the non-control of which is an obstacle to the survival of microfinance institutions. Minimizing the operating costs in order to reduce the charges to be paid by the borrower is, therefore, a challenge for the microfinance system. As part of their activities, microfinance institutions sometimes receive subsidies from governments and international donors to enable them to offer greater access to financial services to those excluded from the traditional financial system. According to Balkenhol (2007), for a microfinance institution (MFI), efficiency refers to its capacity to allocate available resources (its assets, its personnel and the subsidies it receives) and to produce satisfactory results (number of loans granted and financial autonomy, or its effect on the rate of poverty reduction). Therefore, MFIs are expected to do better than traditional or state-run banks in terms of reducing costs and the difficulties related to accessing financial services by the poor or those excluded from the traditional financial system, and in terms of maintaining or increasing their profit margins (Armendáriz and Morduch, 2005). In these expectations lie the challenge with which the MFIs are confronted, namely to achieve both the goal of their social mission as well as that of profitability and/or sustainability, which requires efficient management on their part.

That is why, now that the MFIs have officially been in existence for several decades in the WAEMU area, it is appropriate to raise questions about their efficiency in accomplishing the mission that traditional banks have refused to fulfil for reasons related to high transaction costs and risks. In other words, do the MFIs function in an efficient way within the WAEMU area? What are the different levels of their cost-efficiency? And what explains the differences observed between the MFIs in terms of cost-efficiency? The present study seeks to answer these questions, while at the same time recognizing the fact that an analysis of an MFI's efficiency is quite different from that of a traditional bank, to the extent that an MFI has both a banking mission and a social one (Gutiérrez-Nieto et al, 2009). In order to understand the notion of MFI-related efficiency, it is important to ask how a balance between the two missions can be achieved, and what the means are to achieve it.

## Justification for the study

Analysing MFI efficiency requires taking into account the main goals of microfinance, namely achieving financial profitability and accomplishing a social mission. Achieving these two goals is a big challenge for managing MFIs in relation to the choice of the labour force, compensation policy, and corporate culture (Armendáriz and Morduch, 2005). Managing an MFI requires controlling its costs. Yet, the MFIs operating from within the WAEMU area are confronted with high rates of non-repayment of loans they have granted. The quality of their loan portfolio remains poor compared with the standard[1] required by the Central Bank of West African States (BCEAO). For instance, the gross rate of their loan portfolio deterioration rose from 5.6% in 2004 to 6.2% in 2005, with huge disparities observed between countries (BCEAO, 2008a). The financial stability review published by the central bank revealed that the gross rate was 7.2% in Benin, 4.9% in Burkina Faso, 16.2% in Côte d'Ivoire, 6.5% in Mali, 10.6% in Niger, 2.3% in Senegal, and 4.1% in Togo. From these figures, one can assert that MFIs have difficulty in controlling their operating costs, which in the long run will force them to adopt rigorous strategies for managing their loan portfolio in order to avoid bankruptcy. A fact attesting to the importance of this necessity is the growing number of microfinance institutions under receivership or liquidation. That is the case for large microfinance institutions in Niger, such as the MCPEC network, CPEC TAIMAKO, and the ADDACHE mutual benefit organization, all of which found themselves under receivership or in liquidation (Association ICAR, 2005). And that has also been so with the RCMEC-CI in Côte d'Ivoire from 2008. The number of MFIs that posted negative net results increased, rising from 24.6% in 2004 to 35% in 2005 (BCEAO, 2008a). Some of the MFIs that operated with shareholders' equity during the observation period found themselves with a quasi-lack of funds (BCEAO, 2008a). The preceding calls for an analysis of the efficiency of the microfinance institutions operating from the WAEMU area, whose survival and continuous delivery of services to a large extent depend upon their efficiency.

An efficiently functioning MFI based on sustainability is reflected in continuous access to financial services by the poorest populations. According to Farrington (2000), improving efficiency contributes to effectively reducing the interest rates on borrowers' loans. For his part, Balkenhol (2007) suggests that insisting on efficiency will enable donors to see that while some MFIs function efficiently, they will never achieve financial sustainability, most likely due to the conditions in the local market (notably the high costs related to the labour force and capital, and the low population density) or to a strategic decision not to increase interest rates and other charges. This means that even if efficiency is not a sufficient condition for an MFI to be sustainable in terms of financial performance and improvement in its outreach, it is at least a necessary condition. Indeed, inefficiency could contribute to the failure of an MFI in terms of its survival, with a negative effect on the continuous provision of credit to the people excluded from the traditional financial system. Financial exclusion slows development down and, as a result, delays economic growth and increases poverty and inequality (Beck et al, 2007). This is how the lack of access to credit perpetuates the vicious cycle of poverty.

On the empirical level, research into the efficiency of the microfinance sector has mostly examined technical efficiency in relation to factors that are specific to the MFIs and those specific to regulation (Gutiérrez-Nieto et al, 2007; Qayyum and Ahmad, 2006;

Farrington, 2000). Using a Data Envelopment Analysis type non-parametric approach, Gutiérrez-Nieto et al (2007) showed that microfinance efficiency in Latin America could be explained through the country effect and the MFI status. Applying the same approach, Bassem (2008) studied the efficiency of 35 microfinance institutions in the Mediterranean area over the 2004–2005 period. The study's results revealed that the size of an MFI had a negative effect on its efficiency: medium-sized MFIs were found to be more efficient than the larger ones. Kobou et al (2009) found that the technical efficiency of the MFIs based in Cameroon was influenced by the percentage of female borrowers, the creditor interest rate, and socio-cultural factors (related to Anglophone vs francophone culture). One factor common to all these studies is the focus of analysis on technical efficiency, at the expense of cost-efficiency. Yet, such a focus does not enable one to see the microfinance institution's capacity to truly minimize costs incurred in the provision of financial services to the populations excluded from the traditional banking system.

However, there are studies that follow a second approach. Among them are Mieno and Kai (2011), Hermes et al (2011), and Grégoire and Tuya (2006). Using a stochastic frontier model, Hermes et al (2011) observe that cost-efficiency is negatively correlated with (the depth of) outreach. More specifically, they found that the MFIs that have an average amount of loan relatively low, which is one measure of depth, were inefficient as well. They also observed that the MFIs that had a larger number of female borrowers (which is another measure of depth of outreach) as clients were also inefficient. Their study suggests that an improvement in efficiency will consist in MFIs focusing much less on the poor. For their part, Grégoire and Tuya (2006) found that an MFI's efficiency was affected by the average loan size, the proportion of its net assets, its financial autonomy, the force of its financial leverage, its experience in business, and the proportion of the loans it granted to farmers. According to Farrington (2000), efficiency is measured by the size of an MFI's portfolio, the average volume of its loans, the methodology it follows in granting loans, its sources of financing, and its salary structure.

Very few studies have analysed the efficiency of financial institutions in the WAEMU area. Among them are Kablan (2009), which studied the technical efficiency and cost-efficiency of banking institutions within the WAEMU after the 1993–1996 reforms. Sedzro and Keita (2009) conducted a study on microfinance in the WAEMU area covering the 2000–2002 period, which came to the conclusion that technical efficiency was the same within a given country, but varied between countries. The MFIs in the sample studied by Sedzro and Keita (2009) operated on variable returns to scale, which suggests that there are economies of scale in the microfinance sector. The authors did not, however, include certain variables such as other sources of financing (shareholders' equity and subsidies). Nor did they highlight the social mission of microfinance nor did they econometrically explore the determinants of MFI efficiency in the WAEMU area. It is this gap that the present study aims to fill.

## Objectives of the study

The main objective of the present study is to analyse the efficiency of the MFIs operating from the WAEMU area. Its specific objectives are to analyse the MFIs'

cost-efficiency and then to identify the determinants of the differences in cost-efficiency found between the MFIs. Knowing these determinants will enable a better understanding of the MFIs' financial sustainability and their potential contribution to poverty reduction in the Union. To achieve this objective, the study will use the stochastic frontier method. At the end, a set of recommendations for policy-making and efficient management of the MFIs will be proposed.

Given the research objectives above, the study will test the following hypotheses:

- H1: The microfinance institutions in the WAEMU area will be more efficient if they minimize their cost structure.
- H2a: The higher the MFIs' performance, the higher their efficiency will be.
- H2b: An MFI's cost-efficiency significantly reduces with the volume of loans granted to poor populations.

The remainder of this paper is structured as follows: Section 2 presents the microfinance sector within the WAEMU area, Section 3 explains the concept of efficiency and describes the estimation methods used, Section 4 describes the analytical methods and data used, and Section 5 discusses the results, while the last section is the conclusion in which policy recommendations are made.

# 2. Microfinance within the WAEMU area

The financial system reforms of the 1990s brought about much diversification of the financial landscape in the WAEMU area.[2] From those reforms emerged structures (labelled "decentralized financial systems" or "microfinance institutions") other than banking institutions and financial establishments. As a result, the financial system within WAEMU is today composed of a network of banks and financial establishments, insurance companies, savings banks and postal cheque centres, microfinance institutions, and a Regional Securities Exchange [Bourse Régionale des Valeurs Mobilières, BRVM]. Each of these institutions and establishments plays an important role in the different sectors of the financial market. For example, one of the BRVM's principal missions is to promote a liberal economic policy launched within the WAEMU area through a strengthening of the financial structure of firms and reduction in financial intermediation costs within the Union. The Regional Securities Exchange remains an important financing instrument for the WAEMU countries and since its creation has managed to mobilize CFAF526 billion. Similarly, during 2003, CFAF125 billion was collected (Acclassato, 2009). For their part, insurance companies play an important role in raising savings through collecting premiums and investing them in financial markets. In this systemic configuration, banks constitute the principal component of the network: for instance, in 2005 they collected deposits in the region of CFAF5,175 billion, against only CFAF278.3 billion collected by microfinance institutions (BCEAO, 2008a).

The relationships that link banks to the MFIs are limited to operations of the latter depositing their surpluses of savings and liquidity in the banks, which guarantees their security and the return on them. In addition, some banks allow the MFIs to use their commercial and technological facilities as well as their credit lines. These are lines of supplies of capital provided by financial partners, namely governments, banks and donors. These credit lines are destined to increase the MFIs' credit capacity. According to a report published by Cordier (2011), 69% of funds loaned to MFIs came from financial institutions (commercial banks, state-owned banks and cooperatives) at a regional weighted average interest rate of 7%.

## Regulations governing the microfinance sector in the WAEMU area

The rapid and surprising growth of microfinance institutions in the 1990s led the governments of the WAEMU countries to put in place a regulatory framework for

the sector. As part of the framework, in 1993 they reached a consensus to put in place a specific law to govern mutual societies and savings and credit cooperatives (COOPECs), commonly known by its acronym PARMEC (Projet d'Appui à la Réglementation sur les Mutuelles d'Epargne et de Crédit) law. Since then the MFIs in the WAEMU area have been governed by a set of regulations, among which a law regulating mutual societies and savings and credit cooperatives, its implementation decree, and instructions from the Central Bank of West African States (BCEAO). According to those regulations, organizations that were not set up in the form of mutual or cooperative societies must sign an agreement with the finance ministry in each WAEMU member state. This law has had an influence on the structure of the microfinance market in terms of types of MFIs mainly present in the area.

The MFIs based in the WAEMU area were established essentially as one of three types of legal entity: savings and credit cooperatives, representing 85%; direct loan institutions, representing 7%; and loan-granting schemes, representing 8% (Camara, 2006). These three types of MFIs are present in all the WAEMU countries, except for Côte d'Ivoire and Senegal, where only the latter two exist. Of the three types, only the savings and credit cooperatives are solidly profitable and have an impressive outreach.[3] An MFI's operational structure largely depends not only upon its legal form and the nature of its activities, but also on its relatively different nature arising from local specificities.

Furthermore, the legal framework contains two categories of measures aimed at ensuring MFIs' efficiency and viability in their distribution of loans. These two are: management standards and prudential measures. Imposing management standards on the MFIs was meant to help them maintain financial equilibrium and ensure their sustainability. For the MFIs to meet these management standards, they have to submit a certain amount of statistical information and accounting documents that are intended to reveal the state of indicators that have to be monitored in terms of governance (profit, income and expenses, provision for bad debts, the repayment rate, the debt collection rate, the debtor interest rate, the creditor interest rate, and the rate of borrowing from banks). But the specificity lies in the fact that mutual societies and savings and credit cooperatives are exempted from the taxes related to savings and credit activities, although this exemption does not concern any other secondary profit-making activity (Acclassato, 2009).

However, the very legal framework that was so hastily drafted showed its limits very soon; limits that compromised the efficiency of some institutions as well as the power of the regulatory authorities. With regard to microfinance institutions, the following weaknesses were observed: non-observance of the legislative and regulatory provisions in force, a weakness in the internal control system, the unreliability of financial statements due to a lack of information and management system, and a weakness in the credit analysis procedure. Concerning the regulatory authorities, the following weaknesses were observed: a strong increase in the number of non-viable operating licences, inadequacies in the controls carried out, difficulties in taking and implementing disciplinary action in case of non-observance of regulations, and deficiencies in collecting financial information (Cordier, 2011).

In order to limit the risks related to MFI activities, the central bank set up a Regional Programme for the Support of Decentralized Finance (PRAFIDE) for the period 2005–

2009. The programme was designed to contribute to the modernization of the MFIs' operations and their impact-related performance, while strengthening their financial viability. In addition, in 2007, changes were made to the PARMEC law with a view to regulating all the MFIs by using the same law and enhancing the MFI sector's stability. In order to improve the sector's performance further, the countries in the Union resolved to have a national strategy for the microfinance sector, a strategy aimed at strengthening the sector through a coordination of all the stakeholders. In some countries, such as Mali and Togo, these different strategies are in their second phase of implementation, while in other countries like Côte d'Ivoire, implementation has not yet started. Implementation in Benin has been latent for a long period (Cordier, 2011).

## The financial system in WAEMU countries

Microfinance in the WAEMU countries developed in the context of a financial system dominated by the banking sector. The regional interbank markets, whether bond markets or stock markets, are little developed, with the exception of the public debt market, which has recently seen rapid expansion. In all countries under study, the banking sector is characterized by a high concentration of loans and low levels of assets (International Monetary Fund, 2013). However, there are disparities within each country.

In Senegal, the banking sector is, on average, well capitalized, profitable and has enough liquidity. However, prudential regulations and bank supervision need to be strengthened. The interbank market remains underdeveloped (Imam and Kolerus, 2013b). In Burkina Faso, the banks are also, on average, well capitalized (Imam and Kolerus, 2013a). But the rate at which the country offers banking facilities is low: about 7% in the entire country, owing to high interest rates (between 10% and 12%).

In Benin, the financial system is small-scale and fragmented, offering limited banking facilities (at a rate of about 5% in 2010). At the same time it is the system that has recorded the highest level of financial inclusion in the entire WAEMU region, if one includes the MFIs and postal centres (International Monetary Fund, 2013). It is a system that also suffers from issues related to information asymmetry, creditors' rights, and legal weaknesses, all of which are threats to financial intermediation (International Monetary Fund, 2013).

In Togo, according to Imam and Kolerus (2013a), the banking sector is adequately capitalized but is also exposed to the risk of loan concentration. The financial system in this country is heavily dependent on the public sector.

Some financial systems, such as those of Côte d'Ivoire, Mali and Niger, are confronted with big structural problems, which have often necessitated reforms (as with the Sector Assessment Programme in Mali in 2008). In Côte d'Ivoire, these problems are reflected in the low rate at which the country offers banking facilities (which is between 7% and 10%), the quasi-absence of long-term loans (only 6% of all loans granted in 2008), a low level of financing of the economy, and a low level of capitalization (République de Côte d'Ivoire, 2012). The banking sector in this country has also been experiencing a strong increase in risk costs, a reduction in loan portfolios, and a stark deterioration in profitability (BAfD [AfDB] et al, 2012). Regarding the financial sector in Mali,

the banking sector is adequately capitalized and profitable but inadequately supplied. Financial intermediation is weaker in Mali than in the other countries in the region. Moreover, the financial system in Mali is confronted with several problems, namely limited access to financial services, a considerable number of state-owned banks in the banking sector, and inadequate prudential regulations (Josz, 2013).

In Niger, the financial system has suffered greatly from the financial crises of the 1980s and 1990s, which were mainly due to macroeconomic factors (a long spell of political and economic instability, negative or low economic growth, chronic poverty and low levels of savings on the part of the country's population) and to institutional factors (an inefficient judicial system and weak financial policy) (International Monetary Fund, 2007). The levels of financial intermediation remain low in Niger. In addition, the quality of the loan portfolio, which had much improved since 2002 to become one of the lowest rates in the area in 2007, has since increased and is at a high level again (Imam and Kolerus, 2013a).

## Performance of microfinance institutions

Apart from the regulatory aspect, the microfinance sector continued to expand in the WAEMU member states. In December 2009, the WAEMU area recorded more than 800 microfinance institutions, with the number of service outlets rising from 1,391 in December 2002 to about 5,000 at the end of December 2009. However, according to the central bank, the WAEMU area remains a strongly concentrated market with about 10% of its MFIs holding more than 90% of the loan and savings portfolio, and offering 75% of the services. The Central Bank of the West African States reported that in 2008 these loan and savings represented 8.6%, while the services represented 7.2% of the financial transactions in the entire WAEMU area's economy. Moreover, the sector-based loan distribution revealed that 55% of the loans granted in 2004 were principally oriented towards the trade, catering and hotel industry, and 19% towards the primary sector.

The MFIs often emphasize full financial intermediation, since they finance their portfolios almost exclusively with micro-savings that earn very low or no returns on capital. Some of them more or less combine shareholders' equity with credit lines. Shareholders' equity comprises the balance carried forward, endowment funds, general and non-mandatory reserves, and the net profit after deducting operating grants. The ratio of shareholders' equity (minus subsidies) to total assets was estimated at 17.3% in 2004, against 17.9% in 2003, with high levels of inequality, as Table 1 shows. Indeed, capitalization levels went up in Benin and Mali, but went down in Burkina Faso, Togo, Niger and Senegal. As for Côte d'Ivoire, there was a massive deterioration in capitalization as a result of the quasi-non-existence of shareholders' equity. As in 2003, for Côte d'Ivoire and Togo this indicator remains below the 10% norm required at the international level in the area of microfinance.

**Table 1: Trends in ratio of shareholders' equity to MFI assets in WAEMU countries**

| | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|
| Benin | 14.1 | 18.7 | 18.3 | 20.0 |
| Burkina Faso | 19.3 | 20.1 | 18.5 | 15.2 |
| Côte d'Ivoire | 1.8 | 1.7 | 2.6 | -2.7 |
| Mali | 20.8 | 19.5 | 20.2 | 21.3 |
| Niger | 21.5 | 23.9 | 23.8 | 23.6 |
| Senegal | 28.6 | 28.6 | 27.8 | 26.9 |
| Togo | 8.6 | 10.0 | 6.1 | 6.6 |
| WAEMU (excluding Guinea Bissau) | 16.3 | 18.2 | 17.9 | 17.3 |

Source: BCEAO (2008b)

In order to fully accomplish their social mission, most microfinance institutions receive subsidies from external donors. Although the share of these subsidies[4] in the MFIs' financial resources is relatively low, it has slightly increased in recent years (see Table 2).

**Table 2: Combined sources of the resources of all the MFIs**

| | 1999–2000 | | 2001–2002 | | 2003–2004 | | 2005–2006 | |
|---|---|---|---|---|---|---|---|---|
| | CFAF (millions) | % | CFAF (millions) | % | CFAF (millions) | % | CFAF (millions) | % |
| Subsidies | 16,376 | 5.6 | 16,279 | 4.1 | 15,642 | 2.7 | 19,340 | 2.5 |
| Shareholders' equity excl. endowment funds | 61,265 | 20.9 | 80,838 | 20.2 | 130,909 | 22.2 | 156,677 | 20.4 |
| Savings | 215,664 | 73.5 | 302,819 | 75.7 | 442,009 | 75.1 | 593,756 | 77.1 |
| Total | 293,305 | 100 | 399,936 | 100 | 588,560 | 100 | 769,773 | 100 |

Source: Compiled by the author from several BCEAO monographs

Capitalization and/or subsidies have an impact on the operating costs albeit more in the management of the portfolio quality than in the financial management itself. The portfolio quality deteriorated in 2005, as it rose from the 5.6% in 2004 to 6.2% in 2005, thus remaining above the 5% norm required for microfinance institutions, as Table 3 shows.

**Table 3: Trends in gross rate of deterioration in MFIs' portfolio in WAEMU countries**

| | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| Benin | 2.9 | 2.7 | 5.7 | 6.2 | 7.2 |
| Burkina Faso | 6.8 | 4 | 5.7 | 5.8 | 4.9 |
| Côte d'Ivoire | 11.9 | 30.4 | 5.3 | 9.4 | 16.2 |
| Mali | 4.1 | 4.6 | 7 | 6 | 6.5 |
| Niger | 14.8 | 15.2 | 11.3 | 9.5 | 10.6 |
| Senegal | 3.7 | 3.3 | 3.7 | 3.6 | 2.3 |
| Togo | 13 | 8.9 | 10.3 | 3.9 | 4.1 |
| WAEMU (excl. Guinea Bissau) | 6.4 | 6.7 | 5.8 | 5.6 | 6.2 |

Source: BCEAO (2008b)

The figures in the table above, which are averages, mask large disparities between countries. As a matter of fact, the gross rate was 7.2% for Benin, 4.9% for Burkina Faso, 16.2% for Côte d'Ivoire, 6.5% for Mali, 10.6% for Niger, 2.3% for Senegal, and 4.1% for Togo. The MFIs in Burkina Faso and Senegal thus saw an improvement in the quality of their portfolios. It should be stressed that certain countries, such as Côte d'Ivoire and Niger, were characterized by high levels of portfolio deterioration in the period 2001 to 2005.

Despite the portfolio quality being rather poor, a reduction in the ratio of operating costs to outstanding debts was observed in 2004, as Table 4 shows. Indeed, all the countries recorded rates that were lower than or equal to the required norm of 35% in the year 2004. This result demonstrates that MFIs in the WAEMU area made a lot of effort to reduce their operating costs.

**Table 4: Trends in the ratio of MFIs' operating costs to outstanding debts in WAEMU countries**

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|
| Benin | 42.1 | 45.7 | 29.9 | 19.2 | 22.0 | 24.0 |
| Burkina Faso | 21.1 | 24.9 | 26.6 | 27.4 | 24.6 | 25.0 |
| Côte d'Ivoire | 23.7 | 50.2 | 50.3 | 53.4 | 35.4 | 35.0 |
| Mali | 27.3 | 34.7 | 29.6 | 25.7 | 26.9 | 27.0 |
| Niger | 31.9 | 44.1 | 36.0 | 36.3 | 32.3 | 32.0 |
| Senegal | 20.6 | 20.5 | 22.3 | 21.1 | 18.5 | 19.0 |
| Togo | 26.6 | 19.3 | 33.5 | 27.0 | 28.6 | 23.0 |
| WAEMU (excl. Guinea Bissau) | 27.4 | 33.1 | 31.0 | 25.9 | 24.1 | 26.4 |

Source: BCEAO (2008b)

# 3. Concepts and methods of assessing efficiency

Measuring efficiency is an aspect of a firm's performance that shows its capacity to produce the maximum outputs possible from limited quantities of inputs. Based on the research by Koopmans (1951) on the analysis of production, and on that by Debreu (1951) introducing the coefficient of resource utilization, Farrell (1957) proposes an empirical measure of efficiency which he divides into two components: technical efficiency and allocative efficiency. Thus, a firm is said to be technically efficient if it is capable of producing a maximum number of outputs given a certain amount of inputs, or minimizing the inputs used in production of a certain amount of outputs. Also, when data about prices are available and the objective function of the firm is known, the allocative efficiency can be analysed (Coelli et al, 2005). Taken together, the two components determine the level of productive efficiency (also known as the total economic efficiency). So, if an organization utilizes its resources in a way to achieve both technical and allocative efficiency, it is possible that it will achieve what is commonly referred to as economic efficiency. This can be studied using a function of costs and profits or income. However, the choice between a cost function and an income function depends on the firm's functional objective.

## Input-related orientation vs. output-related orientation

A firm can, in the pursuit of its functional objectives, either minimize inputs depending on the nature of the output sought, or maximize the output given a certain amount of inputs used. The two approaches give the same results for the constant returns to scale and different results for the variable returns to scale (Afonso and Aubyn, 2006; Primont and Domazlicky, 2006; Lee and Worthington, 2008 cited in Kobou et al, 2009). The present study uses the input-related approach, which is useful when assessing a financial institution's performance, particularly its cost-efficiency aspect. This choice was justified partly by the choice of orientation as a function of the quantities of inputs and outputs, which managers are capable of controlling. In this regard, as Kobou et al (2009) point out, it should be noted that managers are more able to control the inputs (personnel and total assets) than the outputs (number of customers and returns on financial assets). Conversely, the MFIs work more with the populations excluded from the traditional banking system because of the cost of their transactions, which the traditional banks consider to be very high owing to the high risk of non-payment involved. Therefore, an analysis of the costs could ensure that the MFIs' efficiency in minimizing the costs exceeds that of banks. Finally, following Hughes and Mester (1993), assuming that an

MFI maximizes its profit amounts to saying that the prices of its products are exogenous and that it does not have market power. This situation seems far removed from the microfinance industry in general, and in the WAEMU area in particular, where the large MFIs occupy more than 80% of the market.

## Methods of efficiency analysis

In the empirical literature, studies of the efficiency of a firm or a microfinance institution have been based on two approaches: a non-parametric and a parametric approach. The non-parametric approach derives from the pioneering research by Farrell (1957) and implies having recourse to linear programming techniques. It estimates a frontier isoquant using the input-output ratios for each firm. The most frequently used technique is Data Envelopment Analysis (DEA). In its original formulation, the DEA technique, put forward by Charnes et al (1978), assumes constant returns to scale. However, the many and varied criticisms levelled against this assumption caused the DEA technique to be relaxed and specified into several variants: variable, non-increasing and non-decreasing returns to scale. The research based on this specification added a further specification in the measurement of efficiency, enabling it to be decomposed into pure technical efficiency and efficiency to scale.

A limitation of the non-parametric methods lies in the fact that sample size plays a greater role in obtaining correct properties than in the case of parametric methods. Indeed, the frontier function estimated using these procedures has no statistical property that enables them to test hypotheses. Because of this, it is very sensitive to extreme observations that are largely responsible for its determination, which requires homogeneity in the size of the sample. However, the non-parametric methods have the advantage of excluding hypotheses that put restrictions on technology and the process of data generation, and on the nature of the firms' deviations from the frontier relative to the stochastic methods.

A parametric approach presupposes a representation of the frontier with an analytical function that is dependent upon a finite number of parameters. There are two major categories, depending on whether the frontier is deterministic or stochastic. The stochastic frontier approach recognizes that there can be two levels of inefficiency on the part of the MFIs and that some of the shocks that are not controlled by these MFIs can affect their activities. That is why the phrase "traditional error term" was added by Aigner et al (1977) and Meeusen and van den Broeck (1977) to the deterministic model in order to render it stochastic. One of the advantages of the parametric methods is that they enable the testing of usual hypotheses. The main problem lies in the specification of the functional form of the frontier, which can result in bias in cases where the specification is erroneous. The most used functions in the literature are the Cobb-Douglas and Translog, since they present the necessary characteristics to explain economic theory and are comparatively simple and easy to estimate (Berger and Humphrey, 1991).

The non-parametric and parametric approaches each have their advantages and disadvantages that have been abundantly pointed out in the literature (Coelli, et al, 2005). The present study has chosen to employ the parametric approach for two reasons: first, the disparities in inefficiency observed among the MFIs cannot be accounted for only

by the bad management of the latter — they result both from an implementation of the wrong management policy and random elements which do not depend on the MFIs. Second, the DEA method requires a homogeneity, not only of the sample in relation to the competitive environment, but also of the size of the firms being assessed. While it is possible to guarantee the homogeneity of the competitive environment, as all the MFIs in the WAEMU area are governed by the same PARMEC law, the homogeneity of the firms' size is not guaranteed.

After describing MFI efficiency, it is appropriate to turn to the possible sources or factors that can explain it with a view to making policy recommendations.

## Methods of identifying determinants of efficiency

Two main approaches have been used in the literature. The first approach explains the degrees of efficiency by using a two-step procedure: they are first estimated based on a parametric or non-parametric frontier, then a regression analysis of the efficiency scores is done on the relevant variables. This approach, developed in the research by Pitt and Lee (1981) and Kalirajan (1981), assumes that the variables accounting for the efficiency are those that the operator does not control in the production process. This assumption has to be made to avoid the bias inherent in the first step, which suggests that efficiency levels are independent of all the variables used, while at the second step they are considered dependent. The advantage of this method is that in case there is a specification error at the second step, the said bias only affects the estimated coefficients of the determinants, and not the coefficients of the frontier. This method is not free from criticism: according to Wang and Schmidt (2002), the two-step method is biased due to the omission of the explanatory variables from the equation that determines the factors accounting for the inefficiency or inconsistency of variables. Moreover, if the determinants in the first-step equation are correlated with those in the second-step equation, then the estimations will be non-convergent and biased.

Theoretical advances (Kumbhakar et al, 1991; Battese and Coelli, 1995; Wang and Schmidt, 2002; Greene, 2005) have attempted to remedy those limitations by proposing a model in which efficiency is an explicit function of its determinants, and all the parameters are estimated in one step by using a maximum likelihood procedure. For instance, for Battese and Coelli (1995), the frontier and efficiency models could have all or some of the explanatory factors in common. These factors are expected to influence both the MFIs' costs and their performance in terms of efficiency.

# 4. Methodology

## The parametric model: Stochastic frontier analysis (SFA)

To analyse cost-efficiency, the present study used the traditional cost function. Thus, the function to be estimated was the following:

$$\ln C_{it} = C\left(y_{it}, w_{it}, \beta\right) + e_{it} \tag{1}$$

where $C_{it}$ represents the total cost that a microfinance institution $i$ incurs at time $t$, $C$ ($y_{it}$, $w_{it}$, $\beta$) represents the cost frontier with $y_{it}$ as the logarithm of the output of the MFI $i$ at time $t$, and $w_{it}$ the logarithm of the costs of the inputs of MFI $i$ at period $t$, with $i$ = 1,...,66 *and* $t$ = 1,...$t_i$, since the panel is non-cylindrical. However, in efficiency studies, the error term $e_{it}$ is decomposed into two components: the cost-inefficiency term and the random error term $v_{it}$. The parameter $u_{it}$ is independently and identically distributed with a truncated normal distribution. The parameter $v_{it}$, of measurement errors and random effects, is independently and identically distributed according to the normal distribution law. These two effects can be summarized as follows:

$$\begin{aligned} u_{it} &: N^{+}(\mu_i, \sigma_u^2) \\ v_{it} &: iddN(0, \sigma_v^2) \end{aligned} \tag{2}$$

Following the speciication of Battese and Corra (1977) for the variance parameters:

$$\begin{aligned} \sigma^2 &= \sigma_v^2 + \sigma_\mu^2 \\ \gamma &= \sigma_\mu^2 / \sigma^2 \end{aligned} \tag{3}$$

the value of $\gamma$ lies between 0 and 1. A null value means that any variance in inefficiency is null and that any deviation from the frontier is entirely due to random effects. A value

of $\gamma = 1$ means that any deviation is entirely due to inefficiency.

Efficiency scores are obtained using the following formula:

$$CE_i = \exp(-\mu_i) \tag{4}$$

An analysis of an MFI's efficiency presupposes a prior specification of the inputs and outputs of its activities. To this end, the main approaches used in the literature are the production approach and the intermediation approach. In the production approach, MFI activities are dealt with in terms of a structure of service production. In this case, an MFI is perceived as using physical inputs such as labour and capital to supply deposit accounts and loan accounts. The intermediation approach is complementary to the production approach, but it differs from the latter in the way it specifies inputs and outputs. Indeed, the intermediation approach perceives a financial institution as a financial intermediary that is supposed to collect deposits by using labour and capital and then supply these sources of funds with loans and other productive assets (Sealey and Lindley, 1977). Thus, the total amount of deposits is an input within the framework of the intermediation approach, while the number of depositors is an output in the production approach.

The present study used the intermediation approach. Outputs in this study are the Gross Loan Portfolio (GLP), measured by the total outstanding loans for the year t. Deposits, or savings, are one of the most important components of MFIs' activities, to the extent that they pose several challenges (Edgcomb and Barton, 1998). As these authors stressed, savings serve several goals: to prove the client's discipline and commitment, to serve as surety against unpaid debts, to serve as financial capital for the group, and, for some programmes, to set up a source of loan funds for the institution itself. As Table 5 shows, in the WAEMU area savings are one of the principal sources of financing for MFIs. That is why they were used in the present study as an input.

**Table 5: Average of the sources of financing as a ratio of the MFIs' assets**

| Variables | Benin | Burkina Faso | Côte d'Ivoire | Mali | Niger | Senegal | Togo | WAEMU |
|---|---|---|---|---|---|---|---|---|
| Deposits/ assets | 0.452 | 0.432 | 0.691 | 0.490 | 0.384 | 0.497 | 0.641 | 0.512 |
| Shareholders' equity/ assets | 0.197 | 0.205 | 0.0347 | 0.217 | 0.315 | 0.254 | 0.086 | 0.186 |
| Subsidies/ assets | 0.209 | 0.319 | 0.009 | 0.115 | 0.077 | 0.094 | 0.091 | 0.138 |

Source: Computed on the basis of author's sample

MFIs, like any other enterprise, use physical and financial capital and labour to conduct their activities. However, their financial capital has specificities: it comprises savings, direct subsidies, and credit lines or borrowings. Each of these components can be considered an input given its specific effect on production and even on costs.

In addition, given the available information it has often been difficult to distinguish between the interest rates charged for borrowings and those paid on savings; however, in the present study the costs of the two inputs have been combined. The cost of borrowings and savings ($W_{BE}$) is given by the amount of the annual interest charged on each amount borrowed by each MFI and the total amount of savings. Physical capital is measured by the tangible assets, the price of which is given by the amount of depreciation allowances divided by the total amount of tangible and intangible assets. This variable is represented by $W_K$. Finally, the cost of labour is measured by the amount of staff charges per year divided by the number of the MFI's employees ($W_L$). It must be stressed that the use of such a measure can cause some bias, given the fact that labour is a heterogeneous production factor, since the employees can have different qualification and education levels, and even occupy different positions within the MFI. However, not enough data was available to enable the present study to explore the effect of this heterogeneity. Moreover, this variable was equally used to enable comparisons between the present study's results and those reported in the literature, where the use of average costs seems to be the norm (Hermes et al, 2011; Kablan, 2009).

Following the research by Hermes et al (2011) and Mieno and Kai (2011) related to various outputs and costs of inputs, certain control variables were added in the present study to the traditional cost function. Thus time, as a factor in the research by Hermes et al (2011), was added to represent MFI technology. This is because, although the MFIs are governed by the same laws throughout the WAEMU area, they use specific technologies depending on the status of each MFI (this can be a non-governmental organization, a savings and credit cooperative, or a non-bank financial institution) and on the area where it is located (whether rural or urban). One should also add the quadratic form of time as a factor, and its interrelationships with the costs of inputs, in order to take into account the dynamic change in the MFIs' performance in terms of cost minimization.

In order to carry out this analysis, the present study used the translog function given the fact that it had also been used in previous studies on cost-efficiency (Hermes et al, 2011; Mieno and Kai, 2011). The empirical form of the translog cost function used here looks like this:

$$\begin{aligned}\ln CT_{it} = {} & \beta_0 + \beta_1 \ln GLP_{it} + \beta_2 \ln W_{Kit} + \beta_3 \ln W_{Eit} + \beta_4 \ln W_{Lit} + \beta_5 (\ln GLP_{it})^2 \\ & + \beta_6 (\ln W_{Kit})^2 + \beta_7 (\ln W_{Eit})^2 + \beta_8 (\ln W_{Lit})^2 + \beta_9 \ln GLP_{it} \ln W_{Kit} \\ & + \beta_{10} \ln GLP_{it} \ln W_{Eit} + \beta_{11} \ln GLP_{it} \ln W_{Lit} + \beta_{12} \ln W_{Kit} \ln W_{Eit} \\ & + \beta_{13} \ln W_{Kit} \ln W_{Lit} + \beta_{14} \ln W_{Eit} \ln W_{Lit} + \beta_{15} t_{it} + \beta_{16} t^2_{it} + \beta_{17} t_{it} \ln W_{Kit} \\ & + \beta_{18} t_{it} \ln W_{Eit} + \beta_{119} t_{it} \ln W_{Lit} + u_{it} + v_{it}\end{aligned} \tag{5}$$

However, the cost function must be linearly homogenous in terms of input costs. To this end, a degree-1 cost homogeneity was imposed by standardizing the total costs

and the costs of other inputs by the cost of labour before carrying out the logarithmic transformation. As a result, our translog cost function can be rewritten as follows:

$$\begin{aligned}\ln(CT/W_L)_{it} = {} & \beta_0 + \beta_1 \ln GLP_{it} + \beta_2 \ln(W_K/W_L)_{it} + \beta_3 \ln(W_E/W_L)_{it} + \beta_4 (\ln GLP_{it})^2 \\ & + \beta_5 (\ln W_K/W_L)_{it}^{\ 2} + \beta_6 (\ln W_E/W_L)^2_{\ it} + \beta_7 \ln GLP_{it} \ln(W_K/W_L)_{it} \\ & + \beta_8 \ln GLP_{it} \ln(W_E/W_L)_{it} + \beta_9 \ln(W_K/W_L)_{it} \ln(W_E/W_L)_{it} + \beta_{10} t_{it} \\ & + \beta_{11} t^2 + \beta_{12} t_{it} \ln(W_K/W_L)_{it} + \beta_{13} t_{it} \ln(W_E/W_L)_{it} + u_{it} + v_{it}\end{aligned} \tag{6}$$

It should be noted, though, that research has shown that Equation 6, which was formulated on the basis of homoscedasticity of the terms of inefficiency and random error, quite often has disadvantages (Caudill et al, 1995; Hadri, 1999; Hadri et al, 2003). For these authors, potential problems related to heteroscedasticity could arise given the heterogeneity between the MFIs concerned. Indeed, as Hadri et al (2003) have pointed out, the presence of heteroscedasticity in an estimation can have a significant effect on the results (biased estimated parameters and invalidation of inference tests). It is, therefore, necessary to correct this harmful effect in order to obtain more robust results. The present study assumed that there would be heteroscedasticity in the inefficiency term. To test this assumption and find the variables responsible for this problem, a regression analysis of the variance of the inefficiency term was applied to the variables under the control of the MFIs, as suggested in the study by Hadri et al (2003). The specific hypothesis tested here is that the loan portfolio is the main variable under the MFI's control.

$$\sigma_{\mu it} = \exp(z_{it}\alpha) \tag{7}$$

where $z_{it}$ represents the size of the loan portfolio and $\alpha$ is a vector of unknown parameters, including a constant parameter. So, after a logarithmic transformation, Equation 7 becomes the following:

$$\ln \sigma_{\mu it} = \alpha_0 + \alpha_1 \ln GLP_{it} + e_{it} \tag{8}$$

Table 6 recapitulates the variables included in the cost function equation.

**Table 6: Description of the model's variables**

| Variables | Definition |
|---|---|
| *CT* | Total cost in CFA francs, comprising both operational costs and financial costs |
| *GLP* | Amount of outstanding loans in CFAF in given MFI's portfolio during year *t* represents the output |
| $W_E$ | Cost of borrowing and savings calculated as amount of interest paid per year divided by amount of borrowing for each MFI and total amount of savings |
| $W_K$ | Cost of physical capital calculated as amount of depreciation allowances divided by total amount of tangible and intangible assets |
| $W_L$ | Cost of labour calculated as amount of staff costs divided by number of employees |
| *t* | Time corresponds to reference year, which in the present study is the year 2000 |

## Determinants of an MFI's cost-efficiency in the WAEMU area

Following Kirkpatrick et al (2008), the cost-efficiency equation was specified as a function of the factors that were endogenous to the MFIs and those that were exogenous to them as macroeconomic variables.

If it is accepted that an MFI has as its basic objective the provision of financial services to the poor with the aim of reducing poverty such a mission, known as outreach, is a very costly one that is likely to create a conflict between improving financial performance, and efficiency. Indeed, according to some authors, such as Hulme and Mosley (1996) and Lapenu and Zeller (2002), the transaction costs associated with small loans are higher than those for bigger ones. This means that there is bound to be a trade-off between outreach and cost-efficiency. In order to take this into account in the present study, two outreach-related variables were used to analyse the relationship between outreach and efficiency. The two are: the average loan size, hereafter represented by *Moypret*, and the percentage of female borrowers multiplied by the number of borrowers in the loan portfolio, hereafter represented by *fem*. It is worth pointing out that this indicator was used by Bassem (2008) and Gutiérrez-Nieto et al (2009) to relate the MFIs' social performance to their efficiency. This choice can be explained by the fact that at the international level it is accepted, notwithstanding national specificities, that women make up the majority of poor populations in the world. After defining the indicators of social performance, we turn to social performance using the notion of an operational self-sufficiency ratio (OSSR).

Slim chances of recovering debt contribute to raising MFI costs, while high rates of bad debt are likely to be proof of MFI inefficiency in loan allocation. Indeed, some studies have confirmed the negative effect of the bad quality of the loan portfolio on banks' efficiency (see, for example, Kablan, 2009; Kirkpatrick et al, 2008). In order to verify its effect on the cost-efficiency of the MFIs in the WAEMU area, the present study appraised the quality of the loan portfolio using the variable (*PAR*) measured by the ratio of the amount of outstanding loans to the total loans.

While the regulations imposed by central bank authorities are designed to stabilize

the banking sector and enhance its performance, they can have a positive or negative effect on MFI efficiency. Since the MFIs in the WAEMU area are governed by a set of rules, it is possible to anticipate the impact of these rules on their functioning. In this connection, the ratio of shareholders' equity to the total amount of assets was used, following Kirkpatrick et al (2008). This variable, hereafter represented by *capactif*, describes the effect of observing those rules, in particular the observance of the required minimum capital, on MFI efficiency. Microfinance institutions draw on several sources of financing in the running of their activities. Indeed, they can get financing through subsidies or private funds. If their source of financing is subsidies, these are likely to contribute to an increase in the MFI's costs if rigorous management rules are not applied. But the opposite is expected if the source of financing is private funds. The variables *depoactif* and *SUB* were used in the present study to relate the sources of financing, or the structure of capital, to MFI cost-efficiency. *depoactif* is the ratio of the total deposits to total assets, while *SUB* is a dummy variable included in the model to describe the effect of subsidies on MFI cost-efficiency. The latter variable was assigned the value 1 if the MFI received subsidies, and 0 if not.

The explanatory variable *tailimf*, measured by total assets, was used to take into account the effect of the MFI's size on efficiency. Moreover, the quadratic form of this variable was introduced to see if a threshold existed beyond which an MFI became inefficient, as suggested by Farrington (2000).

Following Mieno and Kai (2011) and Gonzalez (2007), the variable "MFI's *age*" was included in the present study's model. To measure this variable, the *Microbanking Bulletin*'s structure was used. It categorizes microfinance institutions in the following way: 1–4 years: *new*; 5–8 years: *young*; beyond 8 years: *mature*. Adhering to the learning-by-doing hypothesis, the older the MFI is, the more experience it has acquired, and the better it manages its activities with a view to achieving good performance. This hypothesis was confirmed in the study by Gonzalez (2007), which found that, on average, the older an MFI became, the more it reduced its operating costs and, as a result, the more efficient it became. This means that the hypothesis assumes a negative correlation between the variables *young* and efficiency on the one hand, and a positive correlation between mature and efficiency on the other hand. To avoid the issue of multicollinearity, the variable *new* was not included in the present study's analysis.

The variable "type of MFI" (*Tyimf*), represented by a dummy variable covering the savings and credit cooperatives(*COOPEC*s), the NGOs and non-bank financial institutions (*NBFI*s), was introduced into the model to account for the difference in costs. To avoid multicollinearity issues, the *NBFI* was not included in the regression analysis. Lastly, as made clear by Gonzalez (2007), the drivers of efficiency can be divided into two groups: the MFI's characteristics and those of the country where the MFI is based. According to the author, different countries are likely to be differently endowed in terms of infrastructure (whether physical, financial or other), which will affect the MFIs' operational costs differently. This could be the basis of the different levels of efficiency observed.

With regard to exogenous factors, the variables that were taken into account are described below: first, there is the level of economic growth, which is measured by each country's gross domestic product (GDP). This is a macroeconomic variable indicating the

country's level of economic development, including the quality of its state institutions, the improvement of which is likely to contribute to cost reduction (Fries and Taci, 2005). According to Kirkpatrick et al (2008), incorporating this variable into the analysis enables a description of the level of income of a given bank's customers. Its effect on efficiency is unspecified.

Second, there is the variable "geographic location", hereafter represented as *Loca*. Related to this, dummy variables were created for the seven countries in the sample. *Côte d'Ivoire* was taken as the reference because, as the description in Section 2 showed, this country recorded a weak performance. Table 7 summarizes the variables that were used in the present study's estimations.

**Table 7: Description of the variables used in the estimation of cost-efficiency**

| Variables | Definition |
|---|---|
| *Moypret* | Average loan size; obtained by dividing the amount of outstanding loans by the number of borrowers at time *t* |
| *fem* | Number of female borrowers involved in the loan portfolio at time *t* |
| *PAR* | Ratio of the amount of outstanding loans to the total amount of loans at time *t* |
| *capactif* | Ratio of shareholders' equity to the total amount of assets at time *t* |
| *depoactif* | Total ratio of deposits to the total amount of assets at time *t* |
| *SUB* | Dummy variable which was assigned the value 1 if the MFI had received a subsidy at time *t*, and 0 if not |
| *tailimf* | MFI's size; corresponds to the total amount of assets at time *t* |
| *Age* | MFI's age, or the number of years during which an MFI has been in existence; decomposed as follows: 1–4 years: *new*; 5–8 years: *young*; beyond 8 years: *mature* |
| *PIB* | Per capita GDP for each country at time *t* |
| *Loca* | Geographical location: dummy variables were created to represent the seven countries in the sample; Côte d'Ivoire was taken as reference |
| *Tyimf* | MFI's status; a dummy variable for the savings and credit cooperatives, NGOs and BFIs |

## The data

The data used in the present study were taken from the MIX Market (www.mixmarket.org) and Rating Initiative (www.ratinginitiative.org), which provide data on balance sheets, the percentage of female borrowers and asset statements. The Rating Initiative was added as another source of data because some data about the MFIs were not available for some years of the period under study. For instance, an MFI like PAPME in Benin may have supplied data about female borrowers in an intermittent way over the study period. As the Rating Initiative has compiled case studies about MFIs, it has information that can be used to complement what is not available for a given year. The social indicators came from the *World Development Indicators*, published by the World Bank. Due to the irregularity in transmitting financial data, the panel selected for the present study is

non-cylindrical. However, the study's sample took into account the MFIs that had big market shares in terms of savings mobilization and loan allocation in each country. The study period runs from 2000 to 2008. It should be noted, though, that the study does not cover the MFIs operating from Guinea Bissau due to lack of data on them.

Table 8 gives a statistical summary of the variables used in the translog function. An analysis of the peakedness coefficients (kurtosis) revealed that the distribution of each of the variables was peaked, meaning that the coefficients were positive. Moreover, a look at the skewness coefficients shows that the distribution is asymmetrical and is skewed to the right for all the variables, except for the variable "time", whose distribution is skewed to the left. This confirms the assumption of heteroscedasticity.

**Table 8: Statistical description of variables included in cost function for 2000 to 2008**

| Variables | Mean | Standard deviation | Kurtosis | Skewness |
|---|---|---|---|---|
| *CT* | 1.01e+09 | 1.77e+09 | 12.024 | 2.743 |
| *GLP* | 4.71e+09 | 8.56e+09 | 15.138 | 3.062 |
| $W_K$ | 0.235 | 0.223 | 14.39 | 2.765 |
| $W_E$ | 0.0241 | 0.030 | 43.31 | 5.025 |
| $W_L$ | 2332459 | 3010472 | 119.057 | 8.873 |
| *t* | 5.677 | 2.349 | 1.953 | -0.230 |

# 5. Results

The results of the present study's estimation of the cost function equation are presented in Table 9. This table presents three models: Model 1 assumes that the two error terms are homoscedastic. Model 2 is that of the heteroscedasticity of the inefficiency term that has been corrected. Models 1 and 2 were estimated using the Newton-Raphson technique. Taking heteroscedasticity into account enabled the study to correct the standard deviations of the parameters estimated, as the results of Model 2 show. Model 3, borrowed from Battese and Coelli (1995), indicates the heteroscedasticity of the variance of the random error term and the inefficiency term. Here, unlike in Model 2, the variable responsible for the heteroscedasticity of the inefficiency term is *capactif*, which represents the loan portfolio. The same variable is supposed to be responsible for the heteroscedasticity of the random error term, since it makes it possible to take into account the heterogeneity of the MFIs being studied. This model was estimated using the maximum likelihood method.

The three models were found to be significant, overall, as the Wald statistic $Chi^2$ shows. In the models, the $\mu$ parameter was found to be positively and significantly different from zero. This significance of the inefficiency term means that the MFIs in the WAEMU area operated in an inefficient way, suggesting that they incurred high costs. The $\gamma$ parameter was also found to be significantly different from zero, which means a rejection of the hypothesis that the variance $\sigma\mu$ would be null.

It also transpires from the results that an increase in the gross loan portfolio (GLP) increased the total cost, as indicated by its coefficient that was found to be significant in Model 1. However, while its sign was found to be non-significant in Model 3, an increase in the loan portfolio reduced an MFI's costs. Further, the variable ($W_E/W_L$) had a positive and significant coefficient, which means that the total costs were high. As indicated by its quadratic form, an increase in this ratio led to an increase in the total costs. This result was observed in all three models estimated.

**Table 9: Results of the cost-efficiency estimation**
**Dependent variable: Ln ($CT/W_L$)**

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| **Variables** | **Coefficients** | **Coefficients** | |
| GLP | **1.085 | 0.430) | -0.963 |
| | (0.481) | (1.035 | (1.130) |
| $W_K/W_L$ | 0.304 | 0.392 | -0.644 |
| | (0.452) | (0.458) | (0.396) |

*continued next page*

**Table 9 Continued**

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| **Variables** | **Coefficients** | **Coefficients** | |
| $W_E/W_L$ | ***1.476 | ***1.407 | ***1.688 |
| | (0.395) | (0.396) | (0.321) |
| $GLP^2$ | -0.005 | 0.009 | 0.039 |
| | (0.012) | (0.015) | (0.026) |
| $(W_K/W_L)^2$ | 0.022 | 0.024 | -0.019 |
| | (0.016) | (0.016) | (0.014) |
| $(W_E/W_L)^2$ | ***0.044 | ***0.042 | ***0.018 |
| | (0.006) | (0.006) | (0.006) |
| GLP. $(W_K/W_L)$ | 0.020 | 0.017 | ***0.058 |
| | (0.019) | (0.019) | (0.017) |
| GLP. $(W_E/W_L)$ | 0.017 | 0.018 | -0.000 |
| | (0.017) | (0.017) | (0.013) |
| $(W_K W_L)$. $(W_E/W_L)$ | -0.008) | -0.009 | **0.046 |
| | (0.019 | (0.019) | (0.018) |
| t | 0.301 | 0.286 | 0.120 |
| | (0.0.223) | (0.223) | (0.197) |
| $t^2$ | ***-0.014 | ***-0.014 | ***-0.015 |
| | (0.005) | (0.005) | (0.005) |
| t. $(W_K/W_L)$ | 0.001 | 0.001 | -0.002 |
| | (0.013) | (0.013) | (0.012) |
| t.$(W_E/W_L)$ | 0.002 | 0.001 | -0.001 |
| | (0.008) | (0.008) | (0.007) |
| Cons | 5.477 | 3.695 | 5.528 |
| | (6.030) | (3.604) | (137.21) |
| $\mu$ | ***0.901 | ***0.217 | |
| | (0.312) | (0.069) | |
| $\ln\sigma^2$ | -***0.569 | ***-3.607 | |
| | (0.257) | (0.241) | |
| $i \log t\gamma$ | ***0.990 | ***0.957 | |
| | (0.378) | (0.362) | |
| $\gamma = \sigma_\mu^2 / (\sigma_\mu^2 + \sigma_v^2)$ | *** 0.729 | 0.746 | |
| | (0.075) | (0.008) | |
| Number of observations | 301 | 301 | 301 |
| Log likelihood | -218.7533 | 234.33567 | -150.6890 |
| Wald $chi^2(13)$ | 879.24 | 776.03 | 714.77 |
| Prob>chi2 | 0.000 | 0.000 | 0.000 |

Note:***, **,* represent the levels of significance at the 1%, 5% and 10%, respectively.
The variables "outputs" and "input costs" are in log (.) represents the standard deviations.
In Model 2 (model produced after the correction of heteroscedasticity), the dependent and independent variables were divided by $\ln GLP^{1/2}$.
Models 1 and 2 were estimated using the Newton-Raphson technique, and Model 3 by the maximum likelihood method.

The technology used by the MFIs was found to have a positive effect on an increase in costs, even though it led to a reduction in costs over time. This can be explained by the fact that the technology most used by MFIs for individual loans was very costly in terms of supervision and transaction costs. The observed reduction in costs could be attributed to the technology used by individual MFIs.

Overall, it transpires from the figures of efficiency levels that over the 2000–2008 period, the average level of cost-efficiency (based on Model 2) for MFIs in the WAEMU area was about 27.4%, as indicated in Table 10. This result shows that there was room for the same MFIs to minimize their costs by at least 72.6% for the same input and output costs. However, a 5.2% increase in the level of efficiency was observed, to varying degrees: the highest levels were observed for Niger, Benin, Togo, and Senegal, while Côte d'Ivoire and Burkina Faso had efficiency levels below the average of the entire WAEMU.

Further, an analysis of the variation in cost-efficiency revealed that there was an improvement over the 2000–2008 period overall, and in particular for the MFIs based in Togo, Mali, Benin, Côte d'Ivoire and Burkina Faso. The implementation of the regulatory framework could be an explanation for the MFIs' improved performance in the entire area, although the levels were still low. As for the MFIs based in Senegal, the variation in their cost-efficiency over the period under study was the lowest.

**Table 10: Cost-efficiency levels by country and in entire WAEMU area (Model 2)**

| | Benin | Burkina Faso | Côte d'Ivoire | Mali | Niger | Senegal | Togo | WAEMU |
|---|---|---|---|---|---|---|---|---|
| 2000 | 0.261 | 0.163 | 0.192 | 0.213 | - | 0.274 | 0.243 | 0.237 |
| 2001 | 0.252 | 0.170 | 0.198 | 0.214 | - | 0.277 | 0.251 | 0.241 |
| 2002 | 0.281 | 0.243 | 0.227 | 0.247 | 0.300 | 0.265 | 0.255 | 0.259 |
| 2003 | 0.282 | 0.247 | 0.241 | 0.266 | 0.279 | 0.261 | 0.259 | 0.264 |
| 2004 | 0.287 | 0.252 | 0.288 | 0.270 | 0.282 | 0.265 | 0.279 | 0.276 |
| 2005 | 0.296 | 0.262 | 0.291 | 0.270 | 0.286 | 0.273 | 0.286 | 0.281 |
| 2006 | 0.295 | 0.240 | 0.294 | 0.277 | 0.323 | 0.287 | 0.293 | 0.288 |
| 2007 | 0.297 | 0.246 | 0.269 | 0.279 | 0.292 | 0.283 | 0.296 | 0.283 |
| 2008 | 0.297 | 0.281 | 0.235 | 0.282 | 0.326 | 0.287 | 0.308 | 0.289 |
| **Mean value** | **0.286** | **0.247** | **0.242** | **0.268** | **0.295** | **0.276** | **0.281** | **0.274** |
| **Variation** | **3.6%** | **6.5%** | **4.3%** | **6.9%** | **2.6%** | **1.3%** | **6.5%** | **5.2%** |

Source: Computed on the basis of the results of the author's estimation.
Note: *(-)* means that no observation was made for the year concerned.
Variation corresponds to the difference between the level of efficiency for the year 2008 and that of the year 2000 in per cent, except in the case of Niger

A look at Table 11 reveals that MFI efficiency in the WAEMU area varied with the MFI's status: NGOs were found to be more inefficient than non-bank financial institutions (NBFIs), but more efficient than the savings and credit cooperatives (COOPECs).

Table 12 presents all the factors that are likely to have influenced the cost-efficiency of the MFIs' in the WAEMU area across two models. The first model, referred to as Model 4, corresponds to the second step in the two-step approach used. In order to determine the determinants of MFI cost-efficiency, the Tobit model was applied because cost-efficiency levels varied between 0 and 1. In cases of a limited dependent variable,

the Tobit model produced consistent estimators compared to the ordinary least squares. The second model, referred to as Model 5, arose from a one-step analysis. In fact, it followed on from the results of Model 3.

**Table 11: Cost-efficiency levels by type of MFI (Model 2)**

| | NGO | COOPECs | NBFI |
|---|---|---|---|
| 2000 | 0.253 | 0.226 | - |
| 2001 | 0.256 | 0.234 | - |
| 2002 | 0.274 | 0.249 | 0.307 |
| 2003 | 0.280 | 0.255 | 0.310 |
| 2004 | 0.282 | 0.270 | 0.304 |
| 2005 | 0.289 | 0.275 | 0.306 |
| 2006 | 0.294 | 0.285 | 0.294 |
| 2007 | 0.293 | 0.279 | 0.281 |
| 2008 | 0.301 | 0.283 | 0.277 |
| **Mean value** | **0.284** | **0.267** | **0.297** |

Source: Computed on the basis of the results of the author's estimation.
Note: (-)means that no observation was made for the year concerned.

To avoid multicollinearity issues, a correlation table was drawn (see Annexure A). It transpires that the correlations between the variables were not strong; that is, not subject to multicollinearity. Because of this, regression analyses were done for the different models.

The following variables were found to be significant based on those estimations. In Model 5, the positive sign obtained for the variable *fem*, which is an indicator of outreach, means that the MFIs having a larger number of female borrowers were inefficient. This result, which corroborates the findings by Hermes et al (2011), demonstrates that there is likely to be a trade-off between efficiency and outreach variables for the MFIs that are essentially oriented towards the social goal of microfinance. The result confirms the hypothesis of a trade-off between outreach and cost-efficiency in the WAEMU area among the MFIs that pursue both a profitability goal and a social one. It can thus be concluded that hypothesis 2b was confirmed. Financial profitability was found to have a positive correlation with cost-efficiency. This is indicated by the negative sign for the variable "operational self-sufficiency ratio" (OSSR) in Model 5. This means that if an MFI improves its financial situation, this will contribute to enhancing its cost-efficiency. Likewise, if it observes the prudential standards for capital required by the regulations, it will also enhance its cost-efficiency, as the results of Model 5 show. Indeed, the negative sign for the variable *capactif* in Model 5 is an indication of the significance of capitalization for MFI cost-efficiency.

With regard to the impact of an MFI's size, represented here by the variable *tailimf*, it was found to reduce cost-efficiency, thus significantly increasing the MFI's inefficiency (see Model 4). However, this negative effect diminished as the MFI's size increased, hence the positive sign for the variable *tailimf2*. As a result, it was found that the bigger the size of the MFI, the more efficient it was in reducing its costs. This finding does not confirm Farrington's (2000) idea that beyond a certain portfolio threshold MFIs were no longer efficient. However, although the signs for the coefficients were not found to be significant, the results were different in Model 5.

Similarly, compared with the new MFIs, the newer MFIs and the old ones were clearly found to be more efficient in Model 4, while they were found to be inefficient in Model 5. It could be argued that the results of Model 4 confirmed the hypothesis that the longer an MFI had been in existence, the more likely it would be to see its efficiency improve, since it would have learnt from its mistakes as it gained experience. Indeed, thanks to the use of ICT and the participation of MFI staff in the WAEMU area in various seminars, the management of institutional costs has improved over the years.

Taking into account the results of Model 5, it could be argued that the growth of the microfinance sector across the world has caused a flow of knowledge of good and bad practices; knowledge that is often useful for microfinance institutions. Thus, before they join the market, the new MFIs take advantage of the information that exists on recent good practice in microfinance.

The level of economic growth, measured by each country's per capita GDP, was found to have a positive effect on MFI cost-efficiency. This means that an improvement in the level of economic development for the WAEMU countries, including an improvement in the quality of state institutions, is likely to reduce the costs of the MFIs in the region, as suggested by Fries and Taci (2005).

**Table 12: Determinants of cost-efficiency**

| | Model 4 | Model 5 |
|---|---|---|
| **Variables** | **Coefficient** | |
| **OSSR** | 0.00001<br>(0.00001) | ***-0.005<br>(0.007) |
| ***Moypret*** | -0.0007<br>(0.0008) | 0.072<br>(0.0057) |
| ***fem*** | 0.0003<br>(0.0006) | **0.106<br>(0.044) |
| ***PAR*** | 0.004)<br>(0.004 | 0.548<br>(0.379) |
| ***Capactif*** | 0.002<br>(0.002) | ***-0.494<br>(0.174) |
| ***Depoactif*** | -0.0017<br>(0.0015) | 0.004<br>(0.096) |
| ***Sub*** | 0.0014<br>(0.0017) | 0.108<br>(0.108) |
| ***tailimf*** | ***0.088<br>(0.010) | 1.149<br>(1.663) |
| ***tailimf²*** | ***-0.284<br>(0.035) | -0.589<br>(5.804) |
| **Age** | | |
| Young | *0.003<br>(0.002) | *0.148<br>(0.086) |
| Mature | **0.004<br>(0.002) | *0.151<br>(0.086) |

*continued next page*

**Table 12 Continued**

| | Model 4 | Model 5 |
|---|---|---|
| **Variables** | **Coefficient** | |
| **GDP** | ***0.026 | 0.228 |
| | (0.003) | (0.396) |
| ***Loca*** | | |
| Benin | 0.035 | -0.231 |
| | (0.023) | (0.217) |
| | (0.00008) | |
| Burkina Faso | 0.009 | -0.200 |
| | (0.027) | (0.241) |
| Mali | 0.025 | -0.079 |
| | (0.024) | (0.281) |
| Niger | **0.075 | -0.008 |
| | (0.033) | (0.494) |
| Senegal | 0.027 | -0.232 |
| | (0.024) | (0.146) |
| Togo | **0.050 | -0.272 |
| | (0.023) | (0.367) |
| ***Tyimf*** | | |
| NGOs | -0.020 | ***0.533 |
| | (0.026) | (0.141) |
| COOPECs | *-0.045 | ***0.467 |
| | (0.023) | (0.141) |
| Cons | ***0.714 | 3.395 |
| | (0.126) | (137.986) |
| Inefficiency term variance | | |
| *capactif* | | ***-1.938 |
| | | (0.648) |
| cons | | ***-1.586 |
| | | (0.228) |
| Random error term variance | | |
| GLP | | 0.285 |
| | | (0.280) |
| cons | | -9.374 |
| | | (6.152) |
| Number of observations | 301 | |
| Loglikelihood | 997.08306 | |
| Wald $chi^2(20)$ | 689.82 | |
| Prob > chi2 | 0.000 | |

Note: ***, **,* represent the levels of significance at the 1%, 5% and 10%, respectively.
(.) represents the standard deviations.
The variables Moypret, fem, tailimf, GLP and GDP are in Log.
Model 4 originated from a Tobit estimation of the efficiency scores.
Model 5 originated from Battese and Coelli's (1995) model for the inefficiency term.

The variables for the MFI's geographical location were found to have a positive effect on cost-efficiency. For instance, the MFIs located in Côte d'Ivoire were less efficient than those located in other countries. This finding is understandable because those based in Côte d'Ivoire have suffered the negative effects of the various crises which the country has experienced. Moreover, the same MFIs are confronted with defaults in payment, which are not often taken into account in the legislation, and difficulties arising from the quasi-absence of capitalization. Conversely, in the other countries under study, in addition to the PARMEC law, policies aimed at professionalizing the microfinance sector and increasing their number of clients have been put in place. Most often the policies in question are supported by government structures. The difference in efficiency observed between countries confirms the result obtained by Sedzro and Keita (2009). Compared with the non-bank financial institutions (NBFIs), the NGOs and the credit and savings cooperatives (COOPECs) were found to be inefficient.

In summary, the two models have highlighted the effects of two variables that are common to both, namely *age* and *type* of MFI, which were found to have an effect on MFI cost-efficiency in the WAEMU area. Model 4 added the MFI's *size* and its geographical location as variables, as well as the country's GDP. For its part, Model 5 added the variables operational self-sufficiency ratio (OSSR), percentage of female borrowers, and capitalization (*capactif*).

# 6. Conclusion and policy recommendations

This paper used the stochastic frontier method to examine the cost-efficiency of microfinance institutions based in the WAEMU area. The study is a comparison of the two-step and the one-step approach. Within the framework of the two-step approach, the first step was to estimate the translog cost function so as to determine whether there was inefficiency in the functioning of MFIs in the WAEMU area. The study's analysis showed that these MFIs were inefficient and that the average level of efficiency for the entire WAEMU area was 27.4%. Even though this was a low level, it rose over the 2000–2008 period for all MFIs. Specifically, cost-efficiency improved in all the countries studied, except for Senegal, where its level fell. These results were corroborated by the one-step model.

Thereafter, the search for the factors that influenced this efficiency revealed that some variables had a significant effect on MFIs' cost-efficiency: from the results of the two models, it was observed that this cost-efficiency was influenced by the age and type of MFI. However, the effect of age differed according to the models: while it contributed to improving efficiency in Model 4, it reduced it in Model 5. On the other hand, the type of MFI was found to be the same irrespective of the model. As another variable, the number of female borrowers had a negative effect on cost-efficiency in Model 5. This means that there has to be a trade-off between outreach and efficiency when the MFI pursued both a profitability goal and a social one. The level of operational profitability was found to have a positive effect on cost-efficiency. Similarly, capitalization played an important role in cost-efficiency. In Model 4, the size of the MFI had a positive effect on cost-efficiency, but this effect diminished as the size increased. The country's level of economic growth also increased the MFI's level of cost-efficiency. For its part, the MFI's geographical location contributed to improving its cost-efficiency.

From the different results reported, this paper suggests that banking institutions and governments should strengthen their procedures for supervising the activities of older MFIs, as the hypothesis that these would become efficient over time was not confirmed in all cases. They should also consider implementing governance methods that involve auditing the MFIs that are NGOs and COOPECs in order to provide them with tools capable of improving their functioning.

Governments, MFIs and the populations concerned should put in place policies aimed at increasing the number of female borrowers while at the same time ensuring that they can repay their loans through an appropriate legal framework for those MFIs that aim for both financial and social performance. Banking and government authorities should continue to do everything possible to ensure compliance with measures and prudential

standards so as to enable capitalization of MFIs in the WAEMU region and thus enhance their efficiency. Moreover, given the fact that efficiency depends on factors that are beyond the control of MFIs,factors such as the country's level of economic growth, which, as Kirkpatrick et al (2008) have pointed out, gives information on customers' income, the WAEMU countries should put in place economic and social policies that would enable their populations to increase their income. This paper recommends that in addition to the various laws which the WAEMU countries have passed, they should further promote the microfinance sector by making it more professional and sustainable through mechanisms that facilitate bank lending, and a legal framework to regulate the attendant disputes.

# Notes

1. The standard required by the central bank is a rate lower than or equal to 5 percent.

2. The reforms took place following banks' bankruptcy in 1980s, when most of the banks found themselves in a situation of bankruptcy or quasi-bankruptcy. That was the case with banks in Burkina Faso, nine in Côte d'Ivoire, four in Togo and in Niger, seven in Senegal, and the entire financial system in Benin in 1990 (Moreira, 2001, cited in Acclassato, 2009).

3. All efforts made to extend microfinance services to the populations that have been excluded from the traditional financial systems are classified as outreach. Outreach can be measured as the number of clients served and the number of services (that is, the volume of savings and the total of outstanding loans), or the number of people reached by the programme, or in terms of depth, which is the socioeconomic level of the clients reached by the MFIs (Lafourcarde et al 2005; Olivares-Polanco, 2005; Conning, 1999).

4. The term "subsidies" here covers both endowment funds and investment subsidies.

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# Annexure A

**Table A1: Correlation coefficients for variables affecting efficiency (OSSR - mature)**

| | OSSR | *Moypret* | *fem* | *PAR* | *capactif* | *depoactif* | *sub* | *tailm* | young | mature |
|---|---|---|---|---|---|---|---|---|---|---|
| **OSSR** | 1.0000 | | | | | | | | | |
| ***Moypret*** | 0.1639 | 1.0000 | | | | | | | | |
| ***Fem*** | 0.1382 | -0.1066 | 1.0000 | | | | | | | |
| ***PAR*** | -0.2342 | 0.0113 | -0.0563 | 1.0000 | | | | | | |
| ***capactif*** | 0.3414 | -0.0787 | 0.1369 | -0.1610 | 1.0000 | | | | | |
| ***depoactif*** | -0.0273 | 0.0525 | -0.1255 | 0.1125 | -0.4751 | 1.0000 | | | | |
| ***sub*** | 0.1132 | 0.0185 | 0.2132 | 0.0898 | 0.1167 | -0.0438 | 1.0000 | | | |
| ***tailm*** | 0.1711 | 0.2898 | 0.4733 | 0.0303 | -0.0561 | 0.1385 | 0.1604 | 1.0000 | | |
| **young** | 0.0930 | -0.0695 | -0.1088 | -0.0397 | 0.0100 | 0.0490 | -0.0975 | -0.2229 | 1.0000 | |
| **mature** | 0.1112 | 0.2075 | 0.2546 | 0.1316 | 0.0091 | -0.0066 | 0.3446 | 0.3941 | -0.6037 | 1.0000 |
| **GDP** | 0.0577 | 0.1012 | 0.1029 | -0.1166 | -0.0809 | -0.0029 | -0.1335 | 0.2220 | -0.0157 | -0.0916 |
| **Benin** | 0.0868 | 0.0788 | 0.0305 | -0.0533 | 0.0279 | -0.0950 | -0.1204 | 0.0060 | -0.0097 | -0.0046 |
| **Burkina Faso** | -0.1431 | -0.1456 | 0.1140 | -0.1309 | 0.0249 | -0.0693 | 0.0046 | 0.1056 | -0.0430 | 0.0264 |
| **Mali** | -0.1023 | -0.1538 | 0.0211 | 0.0643 | 0.0665 | -0.0306 | 0.1238 | -0.0979 | -0.0574 | 0.1052 |
| **Niger** | 0.0587 | -0.0917 | -0.0650 | 0.1104 | 0.1250 | -0.0816 | 0.0790 | -0.1052 | 0.0390 | 0.0688 |
| **Senegal** | 0.3245 | 0.0989 | 0.1562 | -0.1290 | 0.1264 | -0.0186 | 0.1514 | 0.1883 | -0.0061 | -0.0114 |
| **Togo** | -0.1209 | 0.0831 | -0.1153 | 0.0874 | -0.1829 | 0.1548 | 0.0701 | -0.0855 | 0.0372 | -0.0023 |
| **NGOs** | -0.0390 | -0.1305 | 0.0593 | 0.0740 | 0.2560 | -0.3419 | 0.1218 | -0.1688 | 0.0767 | 0.0066 |
| **COOPECs** | 0.1120 | 0.1905 | -0.0716 | -0.0089 | -0.2300 | 0.4781 | 0.0009 | 0.2161 | -0.0035 | 0.0525 |

**Table A1: Correlation coefficients for variables affecting efficiency (GDP - COOPECs)**

| | GDP | Benin | Burkina Faso | Mali | Niger | Senegal | Togo | NGOs | COOPECs |
|---|---|---|---|---|---|---|---|---|---|
| **OSSR** | | | | | | | | | |
| ***Moypret*** | | | | | | | | | |
| ***Fem*** | | | | | | | | | |
| ***PAR*** | | | | | | | | | |
| ***capactif*** | | | | | | | | | |
| ***depoactif*** | | | | | | | | | |
| ***sub*** | | | | | | | | | |
| ***tailm*** | | | | | | | | | |
| **young** | | | | | | | | | |
| **mature** | | | | | | | | | |
| **GDP** | 1.00000 | | | | | | | | |
| **Benin** | 0.0060 | 1.0000 | | | | | | | |
| **Burkina Faso** | 0.0409 | 0.1800 | 1.0000 | | | | | | |
| **Mali** | -0.2309 | 0.2896 | -0.1583 | 1.0000 | | | | | |
| **Niger** | -0.3663 | 0.1327 | -0.0725 | -0.1167 | 1.000 | | | | |
| **Senegal** | 0.5560 | -0.2544 | -0.1390 | -0.2237 | -0.1025 | 1.0000 | | | |
| **Togo** | -0.4596 | 0.2516 | -0.1375 | -0.2212 | -0.1025 | -0.1943 | 1.0000 | | |
| **NGOs** | -0.1680 | 0.3518 | -0.0504 | 0.0819 | -0.1541 | -0.2604 | 0.0422 | 1.0000 | |
| **COOPECs** | 0.1164 | -0.3190 | -0.1276 | -0.0589 | 0.1772 | 0.3064 | 0.0166 | -0.8692 | 1.0000 |

**Table A2: Cost-efficiency levels by country in the WAEMU area (Model 3)**

| | Benin | Burkina Faso | Côte d'Ivoire | Mali | Niger | Senegal | Togo | WAEMU |
|---|---|---|---|---|---|---|---|---|
| 2000 | 0.261 | 0.163 | 0.192 | 0.213 | - | 0.274 | 0.243 | 0.237 |
| 2001 | 0.252 | 0.170 | 0.198 | 0.214 | - | 0.277 | 0.251 | 0.241 |
| 2002 | 0.281 | 0.243 | 0.227 | 0.247 | 0.300 | 0.265 | 0.255 | 0.259 |
| 2003 | 0.282 | 0.247 | 0.241 | 0.266 | 0.279 | 0.261 | 0.259 | 0.264 |
| 2004 | 0.287 | 0.252 | 0.288 | 0.270 | 0.282 | 0.265 | 0.279 | 0.276 |
| 2005 | 0.296 | 0.262 | 0.291 | 0.270 | 0.286 | 0.273 | 0.286 | 0.281 |
| 2006 | 0.295 | 0.240 | 0.294 | 0.277 | 0.323 | 0.287 | 0.293 | 0.288 |
| 2007 | 0.297 | 0.246 | 0.269 | 0.279 | 0.292 | 0.283 | 0.296 | 0.283 |
| 2008 | 0.297 | 0.281 | 0.235 | 0.282 | 0.326 | 0.287 | 0.308 | 0.289 |
| **Mean value** | **0.286** | **0.247** | **0.242** | **0.268** | **0.295** | **0.276** | **0.281** | **0.274** |
| **Variation** | **3.6%** | **6.5%** | **4.3%** | **6.9%** | **2.6%** | **1.3%** | **6.5%** | **5.2%** |

Source: Computed based on the results of the author's estimations.
Note:(-) means there was no observation for the year concerned.
Variation refers to the difference (in %) between the level of efficiency of the year 2008 and that of the year 2000, except for Niger.

**Table A3: Cost-efficiency levels by type of MFI (Model 3)**

| | NGOs | COOPECs | NFBI |
|---|---|---|---|
| 2000 | 0.253 | 0.226 | - |
| 2001 | 0.256 | 0.234 | - |
| 2002 | 0.274 | 0.249 | 0.307 |
| 2003 | 0.280 | 0.255 | 0.310 |
| 2004 | 0.282 | 0.270 | 0.304 |
| 2005 | 0.289 | 0.275 | 0.306 |
| 2006 | 0.294 | 0.285 | 0.294 |
| 2007 | 0.293 | 0.279 | 0.281 |
| 2008 | 0.301 | 0.283 | 0.277 |
| **Mean value** | **0.284** | **0.267** | **0.297** |

Source: Computed based on the results of the author's estimations.
Note:(-) means there was no observation for the year concerned.