ABOUT THE ex-ante EFFICIENCY OF MICROCREDIT PROGRAMS IN THE FIRST WORLD

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Abstract:
The paper concerns the analysis of Micro-credit Financial Institutions (MFI) policies in the allocation of resources to business projects. Their Micro-credit Programs' objective is to grant (part of) the capital micro-entrepreneurs lacking material collateral need to found economic activities engaged to self-employment and earnings.
We consider the ex-ante efficiency of a Program based on the decisions and funds finally allocated. Using Data Envelopment Analysis in a panel of data gathered from the MFIs' applications, we characterize its efficient frontier considering various relevant variables to feature all applications submitted to the MFI. We compare results thus obtained with the actual allocation funds made by the MFI, taking into account its mission. This allows us to see the actual relevance of the businesses plans in the final decision to grant a loan, as well as the evolution of the MFIs decisions through time.

Keywords: Microfinance; ex-ante Efficiency; Business plan; developed countries

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1. Introduction

Micro-credit and microfinance are concepts usually associated with non-developed countries. From their emergence in the 1970's, micro-credits have been reported to successfully help social and economic development in the vast majority of non-developed countries (Anderson-Locker, 2002). The substantial resources, more than $200 million, being invested in expanding and replicating micro-credit programs are testimony to their perceived potential for worldwide poverty alleviation (McKernan, 2002).

Micro-credit Financial Institutions (MFI) are present not only in developing countries. It may also be a viable strategy for local economic development to provide credit to micro-entrepreneurs in developed countries, where there are also people striving to start businesses which can be profitable, but lacking collateral, they have virtually no access to conventional banking services related to credit. Nevertheless, to engage in economic activities in the "first world", in Europe in particular, is not as easy as it could be in a less developed, and therefore less formal country. Any formal economic activity has to fulfil a number of legal commitments and requirements (fiscal obligations, for instance) which may undermine the role of a micro-enterprise as a provider of self-employment and earnings.

The question is, then, whether micro-credit programs have also a role in developed countries. Reported experiences seem to be positive, especially from the US and Canada (Conlin, 1999; Painter, 2001). Micro-credit programs are also found all over Europe (European Commission Report, 2003). But some voice the difficulties of micro-enterprise development, mainly because of the alternatives to self-employment (wage jobs and public assistance) provided in those economies, thus reducing the size of the sector (Schreiner – Woller, 2003).

To try to cast some light onto this, we have identified and studied several micro-credit programs in Catalonia and Spain. Despite differences in mission, scope, etc, all MFIs studied share many similarities in their design and implementation procedures. Loans are granted to would-be entrepreneurs or to already existing business or organizations. To qualify, the promoter(s) must lack the resources to proceed with the investment and the material collateral to be granted it from conventional banks. Furthermore, the presentation of a detailed and economically viable – independently certified – business plan is always required. Business projects are analyzed by the MFI staff, usually including interviews with the would-be borrowers to assess their needs, requirements and capacities. Taking into account all data gathered, the MFI must decide upon the convenience to grant a loan, and, if so, which is the amount to be lent (within a given interval, since most of the micro-credit programs have a upper limit to the amount that can be lent).

We can therefore consider the ex-ante efficiency of a given micro-credit program, based on the decisions and funds finally allocated to their prospected clients. The study should be qualified of "ex-ante" because we are taking into account the information given to the MFI at the application time, and not the results obtained by the micro-entrepreneur once the loan is granted. To proceed, and as a first step, we have collected several parameters to characterize both the

would-be entrepreneurs and their business projects. To obtain a personal profile, we have taken into account gender, nationality, age and formal educational level. As to the business project, the legal structure and sector proposed for the economic activity, its location, the estimated initial investment and estimate benefit-rate have been taken into consideration. A third group of data concern the financing sources of the business proposal, including the micro-credit amount applied for, own resources to be used, as well as others (if any) obtained previously by the entrepreneur.

We propose the use of Data Envelopment Analysis, selecting some relevant features of the applications submitted. Therefore, after briefly describing the micro-credit sector in Catalonia (section 2), we define the model to be considered in section 3. Section 4 is devoted to the application of the described methodology to the data of the pioneer micro-credit program in Catalonia and Spain, *Acció Solidària Contra l'Atur*. We characterize its efficient frontier taking into consideration several hypotheses, and compare it with the mission established by the MFI regarding its micro-credit program. Results will also contribute to confirm, but only partially, a well established idea suggested by virtually all MFI consulted, in the sense that the intuition of the staff after an interview with a potential beneficiary is most significant, and that business plans are used only as an initial screening, but with few relevance in the final decision to grant a loan. Section 5 concludes with a few remarks.

2. Microfinance in Catalonia

Catalonian first Micro-credit Financial Institution was an NGO named *Acció Solidària contra l'Atur* (ASCA), established in 1981. Aiming to "promote self-employment for those that have found themselves in precarious condition due to job loss", a Solidarity Fund was settled to provide economic resources to support micro-business initiatives, or simply to acquire working tools to make a living[1]. Also pioneer in Spain, the procedures designed by the micro-credit program of this non-profit association constituted the basis for all other programs set up afterwards.

Any individual or legal entity seeking to enter ASCA's micro-credit program is required to present a detailed business project, and, as a rule, credit awarded will not cover the total investment forecasted. To qualify, potential beneficiaries must be short of resources to proceed without the loan, and also lack collateral to be granted from conventional banks. They usually are also required to have enough (working) experience to guarantee project's viability.

The analysis of submitted applications is made by ASCA's staff (usually volunteers), who meet several times with the would-be beneficiaries to asses their needs, requirements and capacities. Criteria used include economic viability in the medium and long term, but also the quality and

[1] ASCA, whose name can be roughly translated as "Solidarity Group against Unemployment", has also other programs related with its mission. Among others, punctual aids to unemployed with "limit situations" – given without repayment –, or special funds to help illegal immigrants to regularize their situation, can be mentioned.

worthiness of jobs involved, with suitable contracts and working conditions. There is no prior limit to the amount that can be lent to a project, subject only to the appraisal of ASCA's staff. Once a loan is approved, access to credit is immediate, charging no interest rate, and without side-commissions. Repayment is settled individually for each project, according to its forecasted profits, and the tempo established on the agreed business plan.

Nowadays five other Institutions offer their micro-credit program, appearing in rapid succession in the last ten years:

- 1997: a social cooperative, COOP57, begins the provision of financial services to its members, cooperatives and social institutions themselves. Its micro-credit program uses internal funds provided by the cooperative "social-saving" program. Having been a member for at list 3 moths qualifies any associate to apply for a loan, but the presentation of a detailed business plan is also required. A board of external experts evaluates the applications submitted and makes recommendations regarding the appropriateness of the plan and the amount to be borrowed.

- 1998: FIDEM (*Fundació Internacional de la Dona Emprenedora*), an Institution aiming to the promotion of women entrepreneurship, succeeds in attracting a local governmental institution first, and then a savings bank (*Caixa d'Estalvis i Pensions de Barcelona*), to collaborate in a micro-credit program especially designed for women. FIDEM has a social fund settled by its members, which is used as a guarantee for the Institution against any default by its borrowers, but actually the loan is made by the savings bank, following FIDEM's recommendation. Women wishing to obtain a loan to start-up their own business must present a detailed business plan, including a certification of economical viability provided by an independent authorized organization. To further ensure the viability of the project, a member of FIDEM (usually in a voluntary basis) would meet with the micro-entrepreneur. Interviews are considered a key element, since the woman's personality and entourage are regarded as essential as the economic viability in any business project.

- 2001: a non profit Institution linked to a savings bank, *Fundació Un Sol Món* (FUSM), *Caixa de Catalunya*, designs and provide funds for its own micro-credit program aiming "to encourage self-employment within the less fortunate". To proceed easily, the program has created a net of associations from the third sector – non-profit associations aiming to support underprivileged people in various circumstances and geographical regions –, including also communal public organizations promoting local economic development. Organizations within this net, having signed previous agreements of collaboration, are charged with the responsibility of studying and eventually backing-up the submitted applications. In any case, the presentation of a detailed business plan with an economic viability certification is required. Only projects with "green light" – given by an organization within the FUSM's net – arrive to the FUSM' staff. Usually loans are granted under temporal and economic conditions recommended by the member of the net making the proposal.

- 2002: ICO, a governmental bank, launches a program to promote entrepreneurship, and both social and economical development. On its first phase (2002-2004), details of ICOs procedure were similar to FUSM micro-credit program, with a net of non-profit institutions studying and backing-up the projects, but including also a second net, this time with commercial banks, charged to further study the economic viability of the project and eventually provide the financial services to the promoters of the projects. In a second phase initiated in 2005, the first net of non-profit institutions was dropped, and would-be beneficiaries directed to the commercial banks with previous agreements with ICO to support its micro-credit program.

- 2005: Another savings bank, also through its non-profit Institution, *Obra Social de La Caixa*, (*Caixa d'Estalvis i Pensions de Barcelona*), opens its micro-credit line to "any individual aiming to develop an entrepreneurial project for self-employment, and with difficulties to enter the standard financial credit system". The program uses also a net of social organizations (by now, mainly local or regional public organizations seeking to promote economic development) to select and eventually back-up the approved projects.

Although sharing similar procedures for granting loans, the six MFIs – and especially the three NGOs – have different missions, and their respective prospective clients are not exactly the same. This is reflected by loan conditions applying in each program, differences that we have summarized in table 1.

Table 1. Loan conditions of the Micro-credit Programs (2006)

	loan max. amount	annual interest rate	max. refund term	commissions
ASCA	--	0%	--	--
COOP57	130,000 €	6.8%	7 years	--
FIDEM	25,000 €	5.0%	5 years	0.50%+0.25%
FUSM	30,000 €	6.0%	60 months	--
ICO	25,000 €	5.5%	5 years	--
Obra Social La Caixa	15,000 €	unknown	4 years	unknown

Progressive increment, both in the number of business projects that have been supported by the microfinance sector in Catalonia, and in the total resources invested by the MFI, is the result of the micro-finance sector growth. Figure 2 shows the details for the 1998-2005 period.

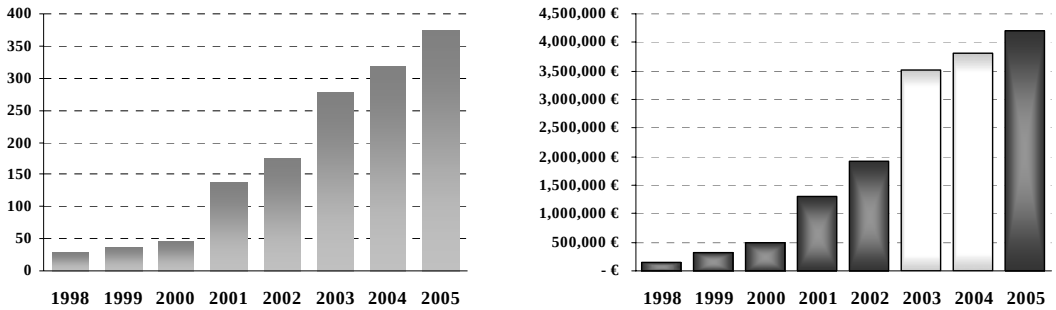

Figure 2. Number of clients and total resources invested by MFIs in Catalonia

3. Measuring the ex-ante efficiency of a Micro-credit Program

In order to propose a measure of the ex-ante efficiency of a Micro-credit Program, we intend to use Data Envelopment Analysis (DEA) to estimate the efficient frontier of the set of applications submitted to the MFI. We shall then define a ratio of efficiency based on efficiency of the allocated resources.

Let's begin with the notation used henceforth. We shall suppose that the applications submitted for funding to any MFI can be expressed as points within the set:

$$A = \left\{ (x,y),\, x \in \mathbb{R}^k \;\; y \in \mathbb{R}^m \right\}$$

where $x \in \mathbb{R}^k$ characterize the relevant attributes of the application, and $y \in \mathbb{R}^m$ expresses the expected attained outputs should the business idea be implemented. Typically, *x* ought to include data related to the business plan (total investment forecasted, loan required, etc) and, if necessary, other features such as the applicants' relevant personal data, economical or geographical sector in which the business idea would be developed, etc. As for the output vector *y* – taking into account that microfinance most general purpose is to provide (self-) employment and earnings to underprivileged people –, the most significant attribute that should be considered is the expected number of (new) jobs involved in the business plan, but others can also be included.

Note that all data featuring a point of *A* concern only information available to the MFI at the time when the decision concerning the allocation of funds must be made. That is to say that we do not consider the actual output attained by a business funded by the MFI, but only those forecasted by its business plan[2]. Therefore results obtained via the *A* set must be referred as to be *ex-ante*.

To measure efficiency, we are interested in the upper boundary of *A*. Following Simar-Wilson (2007), this boundary is formed – in the output-oriented sense – by those firms (or projects, in most cases) which would obtain the maximum achievable output given the level of input:

$$\partial A = \left\{ (x,y) \in A \,/\, (x,\lambda y) \notin A \;\forall \lambda > 1 \right\}$$

This efficiency frontier will therefore contain, among all projects with similar input characteristics, only those that are efficient in terms of the defined output (thus providing the maximum number of jobs, following the previous pattern).

In this context, the classical Debreu-Farrell output measure of efficiency for a unit (project) located at point (*x*,*y*) is:

$$\lambda(x,y) = sup \left\{ \lambda \,/\, (x,\lambda y) \in A \right\} \in \mathbb{R}$$

[2] It should also be pointed out that all business plans have been previously checked by independent experts, so that its economic viability is certified. That is, we can suppose that in its details both the plan and its expected output "make sense" from an entrepreneurial point of view.

which can be interpreted as the proportionate, feasible increase of outputs that could achieve efficiency for that unit. When taking the output to be the number of jobs involved in a given business initiative, $\lambda(x,y)$ would indicate the proportionate increment in jobs that would have to be implemented in the initiative in order to be considered efficient – compared to other business initiatives with similar (input) conditions –. Therefore, only submitted applications with $\lambda(x,y)=1$ will be technically efficient, whereas in all other cases we will have $\lambda(x,y)>1$.

We shall suppose that *A* fulfils the standard technical assumptions used in the frontier models [cfr. Simar-Wilson (2007)]: *A* is closed and convex, with $\lambda(x,y)$ differentiable in both their arguments. Furthermore, we shall suppose strong disposability:

$$if\ (x,y)\in A \ \Rightarrow\ (x',y')\in A\ \ \forall x',y'\ such\ that\ \ x'\geq x\ ,\ y'\leq y$$

that is, with more input it is always possible to attain an inferior level of output..

Let's now consider the set of applications actually submitted to a given MFI or Micro-credit program, possibly during a prefixed period of time:

$$S=\left\{(x_i,y_i)\in\mathbb{R}^k\times\mathbb{R}^m\ ,i=1,...,n\right\}$$

Obviously *S* is a subset of *A*, and can also be considered as a set of known realizations of all possible business plans that can be submitted for funding.

As in the standard Data Envelopment Analysis, we will use the convex hull of *S* as an estimator of the set of all possible applications *A*. We shall denote this new set by $\hat{S}$:

$$\hat{S}=\left\{(x,y)\in\mathbb{R}^k\times\mathbb{R}^m\ /\ y\leq\sum_{i=1}^{n}\alpha_i y_i\,,x\geq\sum_{i=1}^{n}\alpha_i x_i\,,\forall\alpha_1,...,\alpha_n\geq 0\ such\ that\ \sum\alpha_i=1\right\}$$

We will further take the frontier of $\hat{S}$ to estimate the efficient boundary of A.

We can therefore obtain an estimation of the efficient scores $\lambda(x,y)$ by replacing *A* by $\hat{S}$ in the corresponding definition:

$$\hat{\lambda}(x,y)=sup\left\{\lambda\ /\ (x,\lambda y)\in\hat{S}\right\}$$

As it is well known, for any given point (x,y), the efficient score $\hat{\lambda}(x,y)$ can be computed by solving the linear program:

$$max\ \lambda\quad s.t.\quad \left.\begin{array}{r}\lambda y\leq\sum_{i=1}^{n}\alpha_i y_i\\ x\geq\sum_{i=1}^{n}\alpha_i x_i\\ \sum_{i=1}^{n}\alpha_i=1\\ \alpha_i\geq 0\ \ \forall i\end{array}\right\}$$

It should be noted that $\hat{\lambda}(x,y)$ provides a downward-biased estimator of $\lambda(x,y)$, because by construction $\hat{S} \subset A$, and therefore $\hat{\lambda}(x,y) \geq \lambda(x,y)$. Therefore, the number *n* of elements of *S* should be large in order to guarantee a "good" estimation of the (output) efficient scores.

The resultant output efficient scores $\hat{\lambda}_i = \hat{\lambda}(x_i, y_i)$ can be used in different manners to discuss the efficiency of an MFI, or rather the efficiency of the MFI's decisions of funds allocation. In this paper we shall develop two of them, namely:

- Considering the whole collection of submissions received by the MFI in a given period of time, we can compute relative output efficient scores for each application within the group. Therefore, a comparison of the distributions of the $\hat{\lambda}_i$ values associated to accepted and rejected business projects will constitute a good basis to discuss actual criteria used by the MFI when selecting the projects that would be funded.

- Taking into account only the accepted applications, we can introduce an efficiency ratio for the MFI allocation of funds, that we define as:

$$R_A = \frac{\sum_{i=1}^{n} \frac{m_i}{\lambda_i}}{\sum_{i=1}^{n} m_i} = \sum_{i=1}^{n} \frac{1}{\lambda_i} \frac{m_i}{TF}$$

  where m_i is the micro-loan granted to the i-th application accepted, and λ_i is the output efficient score for that project, considering all accepted projects during the period. In the second equivalent formulation of the same ratio, *TF* stands for the total amount of granted funds distributed during the period, $TF = \sum m_i$.

  The underlying reason for such a calculation is the following. Let's suppose that a given business project involves a number t_i of jobs, and it is granted a loan amount m_i. Clearly, the "investment" made by the MFI when granting the loan is $\frac{m_i}{t_i}$ per job. If the project is not efficient, and has an output efficient score λ_i, the number of jobs involved should have had to be $\lambda_i t_i$ (in order to be efficient) instead of simply t_i. Therefore the efficient MFI "investment" should have had to be $\frac{m_i}{\lambda_i t_i}$ per job, which amounts to $t_i \frac{m_i}{\lambda_i t_i} = \frac{m_i}{\lambda_i}$ for the whole project.

  Thus, the numerator in R_A represents the total amount of resources that should have been allocated taking into account the theoretical efficiency of the business projects considered, whereas the denominator stands for the actual allocations made by the MFI. Therefore, it is

also clear that in any case we will have $0 \leq R_A \leq 1$, and $R_A = 1$ if, and only if, all applications submitted and approved are located in the efficient frontier of $\hat{S}$.

Series of these ratios, computed for different periods of a same Institution or for different Institutions in the same period, would allow its study (evolutionary or comparative) in terms of a simple figure summarizing the behaviour of the MFI in each case.

4. Empirical research: the case of ASCA

To apply the methodology described above, we have chosen the Business-Projects subprogram of the Self-Employment program of ASCA. Being the pioneer MFI in Catalonia, we can obtain more data and for a wider period of time. Furthermore, ASCA is a NGO with a transparency policy that facilitates the gathering of relevant data. It is also worth note as an advantage that the applicants to ASCA's program present a more varied scope than other programs, due to its lack of restrictions: ASCA would consider any kind of project, and does not have a superior limit to the granting loan.

The data set considered consist of a total of 290 observations, corresponding to the submissions made to the above mentioned subprogram during a 9 years period, from 1998 to 2006. All data have been extracted by the authors from the documentation kept by ASCA at the time of submission of each application considered.

Prior to any efficiency consideration, we shall briefly describe the features of the applications, as well as some statistics related to the approved ones.

4.1. ASCA's applicants

As we have already pointed out, applications submitted to ASCA's program have a varied scope, ranging from individuals seeking to start-up their own business for self-employment, to non-profit associations employing disadvantaged people aiming to settle a new project.

Using these two criteria – individual and legal entities submission, and the intended use of the loan applied for – table 3 present the total number of applications submitted to ASCA during the relevant period, as well as the rate of admission for each group. It is worth noting that the relative weights of the three motivations for asking ASCA's support are quite dissimilar in the two groups: most individual applications are intended for business start-up, whereas for legal entities the expansion projects are the dominant ones.

Nevertheless, last row of table 3 also shows the result of independence tests made to see whether the "loan intended use" is relevant for ASCA's decision to allocate resources to a business project. For both groups the answer is negative, as it is proved by the high value of the p-discriminator in the test.

Table 3. ASCA's aplications (1988-2006) sorted by groups

	Applicants			
	individuals		non-profit organizations	
Applications intended for	#	admission rate	#	admission rate
business start-up	128	63.28%	3	100%
back-up an existing project	77	66.23%	29	96.55%
expansion project	17	58.82%	36	100%
Total	**222**		**68**	
Pearson's chi-square test p-value	0.957318068		0.994944319	

High figures concerning acceptance within the group of the non-profit organizations' applications have a double explanation. First, it is in the core of ASCA's mission to support alleviation of poverty through such organizations, some of them having submitted more than one project. But a second underlying reason must be mentioned: although a lot of these projects have indeed received governmental or communal subsidies to actually finance them, subsidies will not arrive until the project has been satisfactorily established. Therefore ASCA's role is that of a financial intermediate (lending the required capital at no cost), knowing almost for sure that the loan will be repaid.

As far as to the individual applications is concerned, we have found reasons to affirm that ASCA's program does not favour a given personal profile in the entrepreneurs it supports. As it can be seen in table 4, neither gender nor nationality, formal educational level or age when submitting an application, is determinant in the decision.

Table 4. ASCA's individual micro-entrepreneurs basic profile

	distribution for approved projects		admission rate
Gender			
female	41.55%		62.77%
male	48.59%	(p=0.9449)	63.89%
partners	9.86%		70.00%
Nationality			
Spanish	60.56%		65.15%
South American	16.90%	(p=0.4612)	77.42%
African	13.38%		76.00%
Formal educational level			
Primary school	36.63%		74.00%
Professional school	25.74%	(p=0.1587)	76.47%
High-school	13.86%		51.85%
University	23.76%		64.86%
Age when submitting the application			
(18,35]	30.33%		64.91%
(35,45]	39.34%	(p=0.9929)	62.34%
(45,55]	25.41%		65.96%
(55,81]	4.92%		50.00%

For each category we have consigned, besides its distribution among the approved projects, the resulting values of the discriminators of Chi-square tests made to check the independence of the distributions of the two groups (those endorsed with a micro-credit and those who were not). In any case the test has resulted in the prevalence of the null hypothesis: we have no reason to believe that the distributions are not independent.

4.2. Business projects supported

Characteristics of the business projects submitted to ASCA's programs are also of interest, since efficiency is most probably best measured through quantitative variables such as those considered here. We have summarized in table 5 some significant parameters related to the economic and financial aspects of the business plans, focusing on in the approved projects.

Table 5. Main features of the business projects submitted to ASCA (1998-2006)

	agregate data			individual projects			non-profit assoc.
	distribution for approved projects		admission rate	distribution for approved projects		admission rate	distribution for approved projects
Economical sector							
(retail) trade serv.	25.96%		*71.1%*	37.59%		*70.7%*	1.49%
personal services	12.50%		*70.3%*	15.60%		*66.7%*	5.97%
restaurants/bars/cafeterias	9.62%	(p=0.0004)	*83.3%*	11.35%	(p=0.1227)	*80.0%*	5.97%
marginal groups services	19.23%		*100.0%*	2.13%		*100.0%*	55.22%
other services	15.87%		*61.1%*	15.60%		*52.4%*	16.42%
primary and sec. sectors	16.83%		*81.4%*	17.73%		*75.8%*	14.93%
Estimated total investment (M€)							
(0,6]	19.14%		*63.5%*	18.31%		*54.2%*	20.90%
(6,12]	27.27%		*76.0%*	33.80%		*72.7%*	13.43%
(12,18]	20.10%	(p=0.9341)	*71.2%*	20.42%	p=(0.8780)	*63.0%*	19.40%
(18,30]	17.70%		*75.5%*	14.08%		*62.5%*	25.37%
(30,158]	15.79%		*75.0%*	13.38%		*63.3%*	20.90%
# Jobs involved							
1 (only self-employment)	41.63%		*61.7%*	56.34%		*59.7%*	10.45%
2	22.97%		*75.0%*	28.87%		*73.2%*	10.45%
(2,6]	17.22%	(p=0.0009)	*78.3%*	13.38%	(p=0.6479)	*65.5%*	25.37%
over 6	18.18%		*97.4%*	1.41%		*66.7%*	53.73%
Loan approved (M€)							
(0,3]	15.79%			21.13%			4.48%
(3,6]	37.32%			46.48%			17.91%
(6,9]	18.66%			20.42%			14.93%
(9,15]	12.92%			9.86%			19.40%
(15,48.1]	15.31%			2.11%			43.28%

Note that some of the p-values for the Chi-square tests in the aggregate data have values that are less than 5%, indicating that there are reasons to suppose a highly significant positive association between some specific characteristics and ASCA's decision to fund the project. But the reason is clearly associated with the support to non-profit associations' projects, because considering only individual projects these bias disappear for all features considered. Therefore, we will need to consider a multivariate analysis to see more clearly the reasons behind ASCA's decisions, which would be done using DEA as stated in section 3.

4.3. Efficiency scores

As we have already exposed in section 3, selection of the business projects input and output variables is central to the measurement of efficiency. Following previous reasoning, we will consider the estimate number of jobs involved in a business project as the unique output variable of the model.

Concerning the input variables, our first choice is to include only the financial details of the business plan, summarized in four items: estimated total investment, amount of own resources individuals or legal entities plan to invest in the project, other sources of financing (usually either other loans, from regular banks or MFIs, or some subsidies), and finally the loan amount applied for in the original business plan. In most cases one of the above mentioned items is redundant, because almost all financial plans are well designed, covering the required investment between the three sources of financing. Therefore we are actually considering a model in $\mathbb{R}^4$, with three (independent) input variables and one output variable.

Using a software package specifically designed to analyse Frontier Efficiency with R, named FEAR by its developer, Paul W. Wilson (Wilson, 2007), we have generated output-oriented efficiency scores[3] for all business projects submitted, regardless of ASCA's final decision. Sorting them with respect to this decision, table 6 summarizes some of the relevant statistics concerning the efficiency scores for the different groups.

Table 6. Efficiency scores for ASCA's micro-credit program

	# observations	# points in the efficient frontier	median	mean	variance	maximum
all projects	290	5	13.6729	17.0590	122.5805	55.4066
accepted projects	209	5	13.6511	15.6681	114.7243	41.2013
rejected projects	81	0	18.4438	20.6477	126.4457	55.4066
						p-values (*)
					F-test to compare variances:	0.5801546
					Student's t-test to compare means of the two distr.	0.0005338

(*) alternative hypothesis: true ratio of variances is not equal to 1; true difference in means is not equal to 0

The analysis of table 6 allows us to conclude that the distributions of efficient scores for the two groups (accepted and rejected projects) do indeed exhibit some differences. For one thing, all projects lying in the efficient frontier have been accepted for funding, whereas those very far from it have been rejected. Furthermore, statistical tests made to compare both samples show that efficiency mean is significantly different according to a Student's t-test, although variances are similar in both cases.

[3] FEAR's efficiency estimation commands are designed to compute Shepard (1970) input and output estimates rather than those defined by Farrell (1957). But since the two measures are reciprocal, we have directly obtained the inverses and worked with them.

Nevertheless, it must also be said that efficient scores can not be used as the unique criterion to sort out the whole set of applications in order to obtain ASCA's accepted projects. In fact, only 4.93% of the rejected projects have distances to the efficient frontier greater than any of the funded projects, a figure than can be raised, but only to 11.1%, if we exclude the marginal 5% of approved projects that are far off from the efficient frontier. Figure 7 shows the histograms of the computed efficient scores for the two groups of applications. Visual impression of the shapes and positions of the two distributions stresses the point, and allows also seeing not only their differences, but also their similarities.

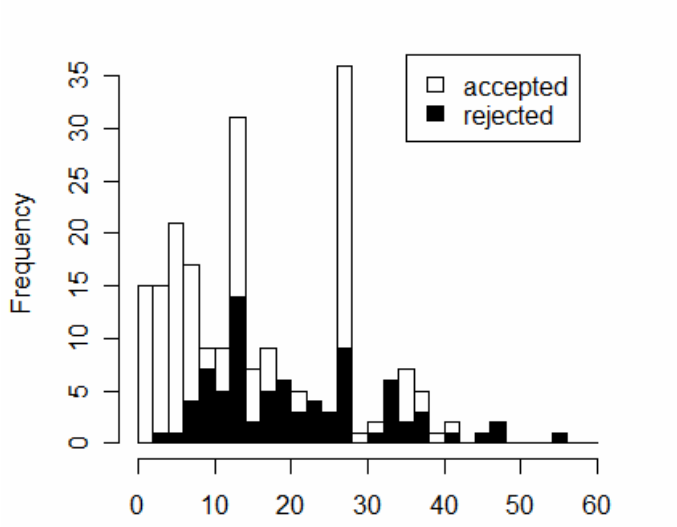

Figure 7. Output efficiency scores

Illustration images of the two distributions can be completed with the plot of their respective densities, which can be found in figure 8. It shows curves that are quite dissimilar. The Kolmogorov-Smirnov test also confirms the differences (although revealing the existence of ties), because the discriminator p-value obtained, p= 0.0009468, is far below the usual 5% allowing the postulate of significant differences.

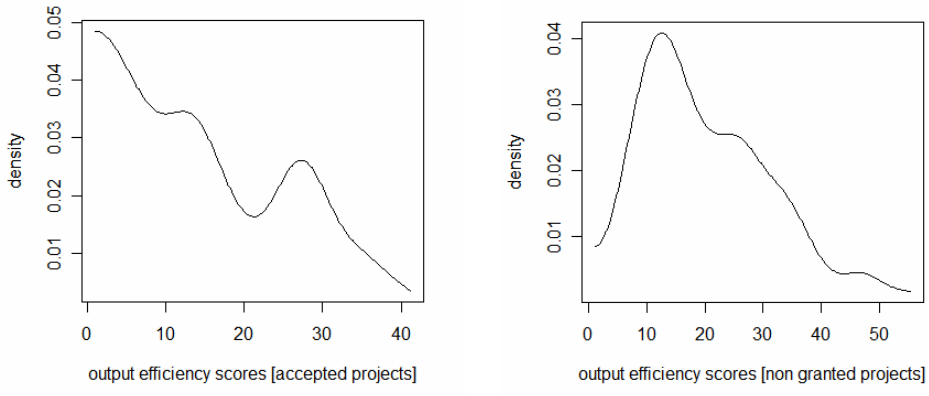

Figure 8. Densities for the two distributions of efficient scores

A striking characteristic of histograms in figure 7 is that it shows quite bimodality, especially considering the set of accepted projects[4]. After the group of accepted projects with "high" rates of efficiency (scores less than 6.0 or even 8.0, accounting nevertheless for only 32.5% of all accepted projects), the histogram shows two peaks. The first one is for the projects scoring in the interval (12,14], and another – the highest – for those in (26,28]. In both cases projects were accepted "despite" being in a much less favourable position regarding their efficiency. The feature is relevant, because between them account for quite 32% of the total ASCA's accepted projects.

Seeking for an explanation, we have turned to the differences in the motivation to apply for a loan, since it is reasonable to think in differences in the financial details of the business plans directly related to the former. For instance, the total investment to start-up a new business is possibly higher than the amount needed to complete an expansion project in a firm of similar characteristics.

The first natural approach to take into account these differences in motivation or context is to add an input variable to the model. Nevertheless, it should be a categorical variable, taking only three integer values, thus colliding with the convex assumption regarding the set of possible observations. Therefore, we have used FDH-output oriented scores[5] to measure efficiency in this case, relying only on the free disposability assumption already mentioned in section 3. Relevant statistics referring to these scores are summarized in table 9.

Table 9. FDH-Efficiency scores for ASCA's micro-credit program

	# observations	# points in the efficient frontier	median	mean	variance	maximum
all projects	290	44	6.2	7.8212	56.1446	32
accepted projects	209	29	6.4	7.6019	48.1692	32
rejected projects	81	15	5	8.3869	77.1330	32
					F-test to compare variances:	0.008441
					Welch t-test to compare means of the two distr.	0.4718

More relaxed assumptions made for the calculation of these efficiency scores result in higher number of projects lying in the (new-defined) efficient frontier[6]. Unfortunately, it also means that one third of them are ASCA's rejected projects. Differences between the distribution of

[4] It is also present in the efficiency scores for the rejected projects, but in much lesser degree, as it is shown in the shape of the corresponding density function.

[5] The FDH estimator was first proposed by Deprins *et al*. (1984), and uses the free disposal hull of the set of observed points instead of the convex hull. It is defined simply by the union of all the south-east-orthants with vertices in the observed points (x_i, y_i):

$$\hat{S}_{FDH} = \left\{ (x,y) \in \mathbb{R}^k \times \mathbb{R}^m \ / \ y \le y_i \ , x \ge x_i \ , \forall (x_i, y_i) \in S \right\}$$

[6] It has to be taken into account also that adding an input variable raises the total dimensionality of the model, thus making it more probable to find extra points lying in the resultant efficient frontier.

FDH-efficient scores for accepted and rejected projects are also present, but only their variances are significantly different, while differences in means can not be considered statistically significant. Figure 10 contains visual information related to those efficient scores, also corroborating the lesser significant differences found in this case.

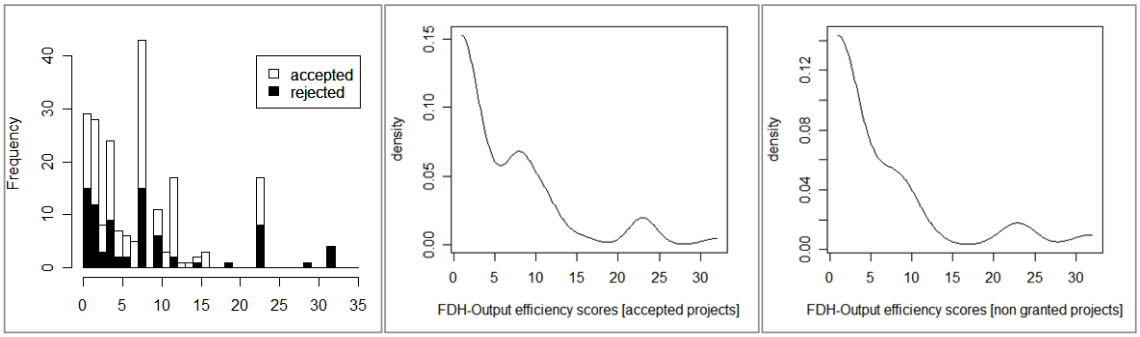

Figure 10. FHD-Output efficiency scores

As alternative, we have split our set of observations in three, according to the applications' motivation. Although having lesser points in each set, we can now compute DEA efficient scores, taking only financial details of the businesses plans as input variables. Table 11 states the summarized statistics for the results obtained, whereas figure 12 contains the corresponding histograms for the three cases.

Table 11. ASCA's projects efficiency scores according to application's motivation

	#	# points in the efficient frontier	mean	variance	maximum	t-tests
business start-up						
accepted projects	81	2	5.6807	6.2911	8.0000	p.var=0.7549
rejected projects	47	2	5.1836	5.7576	8.0000	p.mean=0.2742
back-up existing projects						
accepted projects	79	7	9.9550	64.1086	31.7139	p.var=0.1134
rejected projects	27	1	15.7938	103.0808	47.0162	p.mean=0.0029
expansion projects						
accepted projects	46	3	11.9792	116.4807	33.3077	p.var=0.5692
rejected projects	7	0	23.4937	149.3693	33.6432	p.mean=0.0125

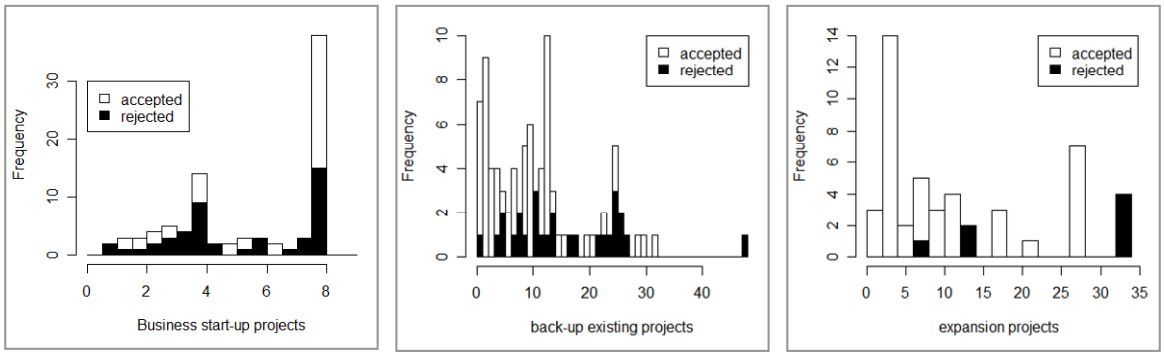

Figure 12. Frequency histograms for ASCA's projects efficiency scores

Combining results previously obtained with those summarized in table 11, we can state some general conclusions:

- Through the study of output-oriented efficiency scores, we can support the conclusion that ASCA's decision to accept a given project for funding is related to its efficiency measured in financial terms.
- Nevertheless, we can not affirm that financial efficiency is the unique criterion used by ASCA in taking its final decision, because also poor rating projects have indeed been funded.
- In particular, the motivation to ask for ASCA's financial support in a project is also taken into consideration, and results differ accordingly.
- For business start-up projects, financial efficiency – in terms the output-oriented efficiency scores determined – of the submitted projects is not quite relevant in ASCA's decision. In fact, as figure 12a shows, the statistical mode for the corresponding distribution in accepted projects is indeed for those far off the efficient frontier. In this case we must therefore support the idea that the intuition of the staff after an interview with a potential beneficiary is most significant, and that business plans are used only as an initial screening, but with few relevance in the final decision to grant a loan.
- On the contrary, for expansion projects, and also for baking-up already existing projects, financial efficiency has a weight in ASCA's decision. In both cases we find differences in the efficiency scores means, significantly lesser in the accepted group than in the rejected one. Furthermore, the spread of efficiency scores is greater for the group of rejected back-up existing projects.

4.4. Efficiency ratios

To finish this section, we have also computed the efficiency ratios defined in section 3. Instead of a single ratio, which would have virtually no meaning in the context of a unique MFI, we have considered efficiency rates per year, that is, taking into account all projects submitted in each of the nine years considered in our study.

Results are stated in table 13, including the total number of projects accepted during each year, mean and variance for the distribution of efficient scores computed, as well as the above mentioned efficiency rates.

Comparing the evolution of those efficiency rates we found a rather interesting characteristic: rates for the 1998-2001 period remain practically constant at 0.32, regardless of the number of projects submitted each year, but with an acceptance ratio also similar. In 2002 there is a skip in the efficiency rate, improving to a more substantial 0.56. With the exception[7] of 2005, this efficiency rate remains also constant for the 2002-2006 period. ASCA's internal conditions and

[7] It is worth noting that during this year ASCA started collaboration with FUSM micro-credit program. As a result, some of ASCA's approved applications where actually financed by FUSM. We have consequently considered, *strictus sensus*, those applications as non-accepted, therefore lowering the corresponding ratio.

board of admission has remained practically unchanged. The only external factor that perhaps could explain this change is that 2002 is the year in which the Spanish currency was switched from pesetas to euros, thus changing the appraisal for investments.

Table 13. ASCA's efficiency rates per year

year	#acc. projects	acceptance rate	# in eff. frontier	effic.mean	effic.var	efficiency rates
1998	29	72.50%	4	9.5473	69.9611	0.32
1999	25	71.43%	4	9.3273	57.1537	0.32
2000	23	67.65%	2	7.5351	19.4889	0.33
2001	34	70.83%	3	11.8447	61.0428	0.32
2002	22	88.00%	4	4.0330	6.2805	0.56
2003	22	70.97%	7	2.9249	3.6689	0.55
2004	17	80.95%	6	2.5001	5.2535	0.54
2005	21	55.26%	4	6.4657	29.9799	0.38
2006	16	88.89%	4	8.6673	89.0142	0.53

5. Conclusion

In this paper we have developed an application of a well known methodology, in a context where quantitative measures of efficiency are not customary. The use of DEA allows the joint study of several variables, relating them to desired outputs, therefore providing significant information that would not be obtained otherwise.

Our use of DEA differs from the most classical examples of this field in the sense that our universe is not a given industry or economical sector, but only a program. Here we do not analyze the efficiency of the micro-credit sector, which should be better compared to other credit services. On the contrary, our objective is the study of the efficient allocation of resources within a given (social) organization. The total observations that can be used in the study are therefore directly related to the size of the micro-credit program considered. Even if the figure can be some times not very high, it has the advantage to constitute the whole universe and not a sample.

When considering decisions reached by social organizations, one must always take into account that typically not only quantitative information would be used. But being careful in the design of the model and variables considered, our study shows that Data Envelopment Analysis provide useful information to measure theoretically ex-ante efficiency, and that the measurement is consistent with actual decisions made by the MFIs.

In particular, we must emphasize the use of efficiency ratios proposed at the end of section 3. With all customary cautions about ratios, they have the advantage to summarize useful information in a single value, thereby providing ground for easy comparisons. For the case

study made in section 4, it has been possible to support the assumption that ASCA's behaviour (concerning allocation resources decisions) has been fairly constant through time.

Nevertheless, the analysis of the efficient frontiers in ASCA's case seems to show less uniformity, particularly bearing in mind the very few projects lying in the computed efficient frontier. But taking into account the variables included in the model – all of them relating to the financial details of the business projects –, it is obvious that only a few projects will exhibit the desired optimal ratio of investment per job involved. Thus, although not lying in the efficient frontier, other projects could also be eligible for funding, particularly being economically viable and closer enough to the efficient frontier. Furthermore, it is also worth noting that the MFI's decisions are restricted to the submitted applications, which could not always be optimal, thus "worsening" its efficiency ratio.

To further validate our model, once proved its usefulness, we are planning to extend the study to the other MFIs in Catalonia. The results of this analysis should enhance the utility of the approach considered in this paper, as well as contribute to a better knowledge of the dynamics of social economy in a developed country.

References

Anderson, C.L. – Locker, L. (2002). 'Microcredit, Social Capital, and Common Pool Resources', *World Development*, 30(1), pp. 95-105.

Conlin, M, (1999). 'Peer group micro-lending programs in Canada and the United States', *Journal of Development Economics*, 60(1), pp. 249-269.

Debreu, G. (1951). 'The coefficient of resource utilization'. *Econometrica* 19(3), pp. 273-292.

Deprins, D. – Simar, L. – Tulkens, H. (1984) 'Measuring Labor Inefficiency in Post Offices', in *The Performance of Public Enterprises: Concepts and Measurements*, ed. by M.Marchand, P. Pesticau, and H. Tulkens, North-Holland, Amsterdam, pp. 243-267.

European Commission Report (2003) *Microcredit for small business and business creation: bridging a market gap.* Enterprise Directorate General of the European Commission.

Farrell, M.J. (1957). 'The measurement of productive efficiency'. *Journal of the Royal Statistical Society, Series A*, 120, pp.253-281.

McKernan, S-M. (2002). 'The impact of microcredit programs on self-employment profits: do noncredit program aspects matter?', *Review of Economics and Statistics*, 84(1), pp. 93-115.

Painter, G. (2001). 'The Microcredit Challenge: A Survey of Programs in California', *Journal of Developmental Entrepreneurship*, 6(1), pp. 1-16.

R Development Core Team (2006). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

Simar, L. – Wilson, P.W. (2007). 'Statistical Inference in Nonparametric Frontier Models: Recent Developments and Perspectives', in *The Measurement of Productive Efficiency*, ed. H. Fried – C. A. K. Lovell – S. Schmidt, Oxford University Press, Oxford, 2nd. ed.

Schreiner, M. – Woller, G. (2003). 'Microenterprise Development Programs in the United States and in the Developing World', *World Development*, 31(9), pp. 1567-1580.

Wilson, P.W. (2007). 'FEAR: A package for frontier efficiency analysis with R'. *Socio-Economic Planning Sciences*, forthcoming [j.seps.2007.02].