FACOLTÀ DI ECONOMIA
UNIVERSITÀ DI BOLOGNA
SEDE DI FORLÌ

Corso di Laurea in Economia
delle Imprese Cooperative
e delle Organizzazioni Nonprofit

Technology Replaces Culture in Microcredit Markets: the Case of Italian MAGs

Federica Calidoni-Lundberg   Alessandro Fedele

Working Paper n. 46
ottobre 2007

in collaborazione con

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CULTURA COOPERAZIONE | NONPROFIT

Federica Calidoni-Lundberg[1]

Dipartimento di Economia, Università degli Studi di Parma

Alessandro Fedele[2]

Dipartimento di Statistica, Università degli Studi Milano-Bicocca

Informazioni :

Facoltà di Economia di Forlì - Corso di Laurea in Economia delle Imprese Cooperative e delle ONP

Tel. 0543-374620 – Fax 0543-374618 e-mail: nonprofit@spfo.unibo.it website: www.ecofo.unibo.it

[1] Federica.calidonilundberg@itps.se
[2] Alessandro.fedele@unimib.it

Technology Replaces Culture in Microcredit Markets: the Case of Italian MAGs*

Federica Calidoni-Lundberg† Alessandro Fedele‡

October 2007

Abstract

Poor local information networks and weak social sanctions in urban settings make joint liability unable to guarantee high repayment rates to microlenders. Yet, microcredit programmes in Western Europe report good performance even if the majority of them charge no collateral. We collect data from three Italian microcredit institutions which operate in urban areas by granting individual loans without collateral to single entrepreneurs and teams (cooperatives and associations) and we find that teams repay with higher probability. On this basis we develop a microlending instrument that, like joint liability implemented in rural economies, extracts information from borrowers through a peer selection mechanism but, differently from joint liability, fits the urban context for it reproduces a cohesion among entrepreneurs based on a profit-maximizing behavior and not on social sanctions.

JEL codes: D82, L31, O12, O16.
Keywords: Microcredit, Urban areas, Adverse Selection.

*We are grateful to Emanuele Bacchiega and Tridib Sharma for valuable suggestions. We also thank Vittoria Cerasi, Pierpaolo Giannoccolo, Enrico Minelli, Luca Panaccione, seminar audience at Università di Bologna, Università LUISS di Roma, Università di Milano-Bicocca and the IV "Civil Economy: young economists' contributions" (Forlì, June 8-9, 2007) for useful comments, Cinzia Melograno, Cinzia Armari, and, especially, Barbara Aiolfi for the time spent helping us to collect the data. The usual disclaimer applies.

†Institutet för tillväxtpolitiska studier (ITPS), Studentplan 3, SE- 831 40 Östersund, Sweden and Dipartmento di Economia, Università degli studi di Parma, Via Kennedy 6, 43100 Parma, Italy; e-mail: federica.calidonilundberg@itps.se.

‡Dipartimento di Statistica, Università degli studi di Milano-Bicocca, Via Bicocca degli Arcimboldi 8, 20126 Milano, Italy; e-mail: alessandro.fedele@unimib.it.

1 Introduction

Microcredit programmes provide financial services to small-scale entrepreneurs who otherwise lack access to capital markets because not endowed with assets to be pledged as collateral.

Empirical evidence shows that these unconventional lenders have a reasonable degree of financial self-sufficiency even if they target poor people who would not be welcomed as customers by ordinary commercial bank. One of the reasons for this success is the application of joint liability: when informational asymmetry between lenders and entrepreneurs is more severe than among entrepreneurs themselves, this scheme of lending is able to mitigate adverse selection problems, *inter alia*, without requesting any pecuniary collateral (for exhaustive surveys see, e.g., Ghatak and Guinnane [6]; and Fedele [5]). Joint liability works as follows: entrepreneurs, who differ in their ability of repayment and work on distinct projects, self-select into groups to get a loan. If the group does not fully repay its obligations, then the microlender cut off all members from future credit until the debt is repaid, so that the successful entrepreneurs are induced to help failing partners. If entrepreneurs have perfect information about each other's type, then joint liability drives the good ones to choose partners of the same type, while the bad entrepreneurs have no choice but to form groups with other bad ones: this is called peer selection and enables the microlender to screen out entrepreneurs. As a result, repayment rates and welfare rise with respect to lending to individuals when no ex-ante collateral is put up. This model of lending turns out to be effective in serving clients who belong to rural communities, where networks of local information are strong and peer pressure from fellow villagers, like reputation loss of insolvent entrepreneurs or restriction on access to inputs necessary for the business, induces discipline in repayment.

On the contrary, many experiences show that in urban industrialized areas joint liability scheme may be a poor fit for potential clients. NEF [13] and Viganò et al. [14] (henceforth NEF and Viganò) find that 79% of the existing microcredit experiences in Western Europe makes only individual loans, just 4% adopts group lending with joint liability and 17% makes both individual and group loans. This is motivated by the fact that people who live in cities are less likely to know each other, so that peer selection may not occur: Laffont and N'Guessan [12] show that repayment rates do not increase with joint liability if entrepreneurs ignore the ability of repayment of partners. Furthermore, social sanctions are less important so that pressure to repay is weaker and joint liability schemes become inappropriate (Ghatak and Guinnane [6]; Ciravegna [3]). If microcredit in the poor world finds its reason to exist in the need to alleviate poverty, the most important rationales for the spread of microcredit in the developed world, where tax, legal, welfare, employment and banking systems are different, are to create employment, integrate minority groups and increase female participation in the workforce; microlending becomes thus a tool to increase social inclusion, in contrast with the original view of the under-developed countries where the main force leading to the successful repayment of microloans is the strong social network (Anderloni [1]; ILO [9]).

Interestingly, the institutions surveyed by NEF and Viganò declare a high average repayment rate of 90.3%, even if the majority of them charges neither joint liability *nor* collateral.[1] Yet, the two reports do not mention whether alternative lending schemes help to maintain such positive results.[2]

To get a more detailed picture of features of microcredit programs in urban settings, we study the case of three microlenders which operate in Northern Italian cities: MAG2 Milano, MAG4 Torino and MAG6 Reggio Emilia. They target two main categories of entrepreneurs, single entrepreneurs and teams (cooperatives and associations), and make individual loans without requesting collateral. We collect data on interest and repayment rates and we find that (i) single entrepreneurs are charged a higher average interest rate and repay less often than teams, (ii) between teams, cooperatives ensure a higher repayment rate and pay a lower average interest rate than associations.

With the aim of developing a deeper understanding of how microcredit contractual instruments should be designed to fit urban contexts, we construct the following theoretical framework: a microcredit market is considered with adverse selection à la De Meza and Webb [4] and Laffont and N'Guessan [12]. Two types of entrepreneurs are present who need funding to implement risky projects and differ in their ability to produce output. Before applying for loans, entrepreneurs decides simultaneously whether (1) to perform individually the project, or (2) to constitute production teams, whose size is exogenously fixed by the financial agreement. The entrepreneurs know only their own type: they live in cities where people do not know each other. Yet, they are supposed to have raised costless perfect information about others' type when building a team: people participating in a common project and focused on its success are induced to look for potential partners whose reliability they already know. We think, for instance, of friends or colleagues.

Loans are granted by a microlender who requires no collateral, knows the fractions of good and bad entrepreneurs in the population, but ignores which specific entrepreneur is of which type. Loans consist of different lending schemes, that the microlender commits to implementing conditional on and before the

[1] See Kugler and Oppes [11] for a discussion of the ability of collateral to mitigate informational problems in urban microcredit programmes with joint liability, where social sanctions are too weak to serve the role of collateral substitutes.

[2] Armendáriz and Morduch [2] list a number of innovations in the microlending practice that go beyond joint liability and help to maintain high repayment rates also in places with scarce local information: among such innovations, progressive lending, which is adopted by around 50% of the institutions surveyed by NEF and Viganò, consists of granting an initial small amount of money, whose size increases successively only if the borrower demonstrates reliability (see also Giné *et al.* [7] for an experimental analysis). The scheme enables microlenders to screen out the worst clients before taking additional risk by expanding loan scale, but presents at least a disadvantage: when there is a multiplicity of microlenders, borrowers who default on a loan can turn to another financial provider if there is poor information on credit histories, so that threats to not be refinanced lose vigor.

entrepreneurs' choice between alternatives (1) or (2).[3]

If all entrepreneurs choose to perform singularly the project, the microlender grants individual loans: this mechanism is designated as Individual Lending scheme. If, instead, all entrepreneurs decide to build teams, a screening mechanism, which consists of two contracts and is denominated as Production Team Lending scheme, is executed. The first contract contains a certain repayment and requires each team to adopt a technology A, for which expected output is increasing and convex in the number of good members. The second contract prescribes a higher repayment and the use of a technology B, for which expected output is (a) linearly increasing in the number of good entrepreneurs, (b) higher than expected output with technology A when all members are bad and (c) equal to when all members are good. If members know each other, convexity of technology A is a sufficient condition to have peer selection: teams arise with either all good or all bad entrepreneurs. On the contrary, profits depend on the entrepreneur type and not on team composition, when technology B is adopted. Good entrepreneurs end up by selecting the first contract for the associated repayment is lower; bad entrepreneurs, who fail more often if they employ technology A, prefer the second contract even if it entails a higher repayment. This enables the microlender to screen between good and bad entrepreneurs and overcome the informational problem.

When, finally, some entrepreneurs choose to form teams and others to perform individually the project, lending mechanism is called Mixed Lending and consists of a different pair of contracts. The first one is addressed to teams: it contains a repayment, requires the teams to adopt a technology which consists of a linear combination of technologies A and B and is denominated mixed technology. The second contract is designed to suit single entrepreneurs and specifies a higher repayment due by them only if successful. Again peer selection occurs when the mixed technology is utilized. Good entrepreneurs select the first contract for the associated repayment is lower, while bad entrepreneurs, who fail more often if they form teams, prefer the second contract even if it entails a higher repayment.

We solve the static Bayesian game played by the entrepreneurs when they choose between alternatives (1) or (2) and we find that two scenarios arise at equilibrium: (i) all good entrepreneurs choose to constitute teams by adopting mixed technology, while all bad ones stay alone and repay with lower probability; (ii) all good entrepreneurs form teams among them by choosing technology A, whereas bad ones build teams with peers by selecting technology B and repay with lower probability.

Our results suggest that targeting teams with high degree of complementarity among tasks may represent a good microlending strategy in urban areas where no collateral is put up and social capital is weak. Indeed, when building production teams entrepreneurs participate in a common project and are focused on its success, thereby being likely to gather information about potential

[3] Throughout the paper, we refer to the microlender as "he" and to each entrepreneur as "she".

partners' ability of producing output, as mentioned above, and to reproduce a cohesion typical of joint liability schemes, but based on a profit-maximizing behavior and not on social sanctions. The more important the contribution of (good) members is, as it occurs with technology A, the more effective the profit-maximizing behavior is in inducing peer selection. For these reasons, our instrument may represent an useful alternative to joint liability in urban developed settings, where networks of local information are highly fragmented and social ties are weak. Moreover, the problem of competition among microlenders is not related to our scheme, since it does not entail threats of future denied access to credit (see Note 2).

Our model also proposes a possible explanation of the good performance of teams (and cooperatives) among MAGs' clients: if one thinks of teams that adopt technology A as cooperatives, while identifying teams with technology B as associations, then the pool of cooperatives and associations can be thought as an example of mixed technology. In this case the first equilibrium scenario describes the situation where teams turn out to be less risky than single entrepreneurs and enable the microlender to charge a lower interest rate. Our model explains this empirical finding by arguing that teams count only good entrepreneurs, while single entrepreneurs are bad. Second scenario illustrates by means of the same reasoning the situation where cooperatives seem to be better clients than associations.[4]

The remainder of the paper is organized as follows. Section 2 provides further details of NEF and Viganò surveys. In Section 3 we carry out the MAGs data analysis. The basic model is laid out in Section 4. Sections 5, 6 and 7 present Individual Lending, Production Team Lending and Mixed Lending schemes, respectively. Section 8 studies the equilibrium and Section 9 concludes.

[4] The Italian Civil Code helps to meet a possible explanation of our interpretation of cooperatives and associations. It defines as cooperative any organization of people that operates for a common purpose, where each member has to answer for social obligation in case of compulsory severance or bankruptcy (in the specific case of loans received by the MAG, no pecuniary collateral is required; however, once the activity of the cooperative starts, new actors who require financial guarantees come into the picture, such as suppliers and customers). Rights and duties of people who constitute associations, on the other hand, are such that less emphasis is put on both organizational aspects and financial obligations. As a consequence, cooperatives bring more pressure on the members to make them perform well: tasks within cooperatives display bigger complementarity. On the contrary, single contributions of the good entrepreneurs within associations are less related to team composition. Furthermore, cooperatives require generally higher initial fixed organizational costs: this is why we assume, even if we do not introduce explicit costs, that teams with technology A produce smaller (gross) expected output than teams with technology B when all members are bad. Such costs are compensated when the huge complementarity degree among single contributions of good entrepreneurs with technology A is totally exploited, i.e. when members are all good: in such a case the same (gross) output is assumed to be produced by both technologies.

2 Microcredit in Western Europe

The development of microcredit in Europe has been quite widespread in the last decades but with different features compared to the original idea of Muhammad Yunus, based on joint liability.

The literature concerning European industrialised countries is still limited with two relevant surveys as cornerstones of the existing work, the aforementioned NEF and Viganò, which help to understand the current state of microcredit in Europe: 30 organisations were contacted by NEF and 32 by Viganò, with an overlapping of 11 that leads to a total of 51 interviews. 59% of the institutions do not ask collateral for the loan and only 44% provide non-financial support services. Microcredit experiences can be found in many countries in Western Europe (Ireland, Spain, Portugal, Belgium, Finland, Italy, Germany, United Kingdom, France, Sweden and Norway) and, given the contrasting legal and regulatory environment, they seem to assume different institutional forms. The most common are Cooperatives (31%) and Foundations (25%), followed by non-bank financial institutions (19%), NGOs (9%), associations (9%) and banks (7%). As mentioned above, 79% of the surveyed organisations make only individual loans, 4% only group loans and 17% make both individual and group loans; the greatest coverage and outreach is taking place in France with 52.7% of the loans made by all the microlenders, followed by Finland with 27.3%; 90% of the microcredit institutions give loans for start-up of entrepreneurial activities. Some other relevant statistical findings by NEF and Viganò concern the financial characteristics of the loans: the average loan size around Europe is 12500€, with average loans terms of 33 months and interest rates that range from a minimum of 0% to a maximum of 19.5%, with an average of 6.8%. Finally, repayment rates range from a minimum of 50% to a maximum of 100%, with average repayment rate of 90.3%.

3 The Italian MAGs: Data Analysis

While reviewing the existing literature on microcredit we became immediately aware of the lack of a unique and clear definition of microcredit, especially in industrialised countries where many institutions tend to call themselves microlenders every time they lend sums below € 25000, requiring both pecuniary and personal collateral. Therefore our first step was to choose an unambiguous definition of microcredit institution as an organization that lends money to "active poor" for start-up of business activity without asking any pecuniary collateral and provides support services to allow the entrepreneur to make the loan fruitful.[5]

In Italy the institution that better fits our requirements is MAG (Mutua

[5] Gonzalez-Vega [8] defines active poor as those people that, even if living in poverty, prove to be technically skilled to such a degree as to enable them to develop, and autonomously run, an economic activity, or to at least produce a constant flow of resources which can be used for repayment of debt or for savings.

Autogestita), a national entity divided in six regional groups; of these only three provide loans to business activities: MAG2 Milano, MAG4 Torino and MAG6 Reggio Emilia. The first MAG was created in 1978 in Verona in order to satisfy the increasing need for new financial tools to support projects with a social implications that would not otherwise get funds in the traditional financial markets. MAGs are Cooperatives or, as they prefer to define themselves, self-sustainable societies of people that save and use private capital to finance fruitful projects. They are therefore authorised by the members to lend money to other members with favorable interest rates and repayment conditions, providing support services and without requiring any pecuniary collateral.

The empirical analysis of the data available from the three MAGs is based on 337 loans for start-up of business activities. We study the difference between loans to individuals and to teams both in terms of interest rates and repayment rates. By September 2005 the three MAGs had provided 277 loans to teams and 60 to individuals; 88.4% of the loan contracts were already expired. This recalls MAG's original objective of financing organizations with strong participation of workers and investors in the business activity.

We first compute the average values of the interest rate for (i) individuals and teams, (ii) within the latter, for cooperatives, on one hand, and associations, on the other. We then define the repayment rate as follows:

$$\frac{\textbf{Amount repaid at time } t}{\textbf{Amount due at time } t}$$

and compute its average values. Tables 1 and 2 below show the outcome of our analysis on MAGs' data.

Table 1: MAGs Data Analysis: Teams vs. Singles

	Number	Repayment Rate	Interest Rate
Loans to Teams	277	87,36%	8,78%
Loans to Single Entrepreneurs	60	76,47%	9,33%

Table 2: MAGs Data Analysis: Cooperatives vs. Associations

	Number	Repayment Rate	Interest Rate
Loans to Cooperatives	165	88,42%	8,48%
Loans to Associations	112	85,79%	9,23%

Table 1 suggests that lending to teams is less risky and enables the microlender to charge a lower interest rate according to the purpose of promoting employment and social inclusion through favorable financial conditions. Disaggregating the data on teams, we find that cooperatives are better clients than associations. The remainder of the paper develops the theoretical framework.

4 The Model

Consider a microcredit market with $N = 4$ wealthless risk-neutral entrepreneurs of two types. Entrepreneurs of type $\tau = H$ propose productive projects which yield A with probability $p_H = 1$. Risky projects of type $\tau = L$ entrepreneurs yield A with probability $p_L = p$, $0 < p < 1$, and zero otherwise. Each entrepreneur needs one unit of capital to implement the project. Money is provided by a risk-neutral microlending institution. Throughout the paper we refer to type $H\,(L)$ entrepreneurs as good (bad). Opportunity cost of labor is equal to 0, while $\rho > 1$ is per unit opportunity cost of capital. The two values represent reservation profits of entrepreneurs and microlender, respectively.

Before obtaining funding, the entrepreneurs decide whether (1) to perform singularly the project, or (2) to form production teams. Teams must count $n = 2$ members. Two entrepreneurs are type H and the other two are type L in the population. The entrepreneurs know only their own type. Yet, they are supposed to have raised costless and perfect information about others' type when building a team. On the contrary, the microlender knows that half entrepreneurs are type H and the other half are type L, but ignores which specific entrepreneur is of which type: there is informational asymmetry.

In case (1), as specified above, each entrepreneur needs one unit of capital as input: if the entrepreneur is good, output is equal to A; if she is bad, expected output is pA. In case (2) each team needs two units of capital as input and expected output depends not only on the entrepreneurs' type, but also on the technology they decide to avail themselves of, as we will see below.

Before the entrepreneurs' choice between (1) and (2), the microlender announces that he will execute different lending schemes conditional on such a choice. Three situations may arise: all entrepreneurs perform singularly the project, in which case the microlender implements individual loans, that we refer to as Individual Lending scheme (henceforth IL); all entrepreneurs constitute teams, then the microlender executes a pair of screening contracts, which is denominated as Production Team Lending scheme (henceforth PTL); finally, two entrepreneurs build a team and the other two perform individually the project, in which case the scheme consists in a different pair of screening contracts and is called Mixed Lending Scheme (henceforth ML). Detailed features of the three financial mechanisms are delineated in Sections 5, 6 and 7.

4.1 Timing and Game

Timing of the model is as follows.

1. At $t = 0$, Nature draws a type vector ς from the set $(\varsigma_1, \varsigma_2, \varsigma_3, \varsigma_4, \varsigma_5, \varsigma_6)$, where $\varsigma_1 = (H, H, L, L)$, $\varsigma_2 = (H, L, H, L)$, $\varsigma_3 = (H, L, L, H)$, $\varsigma_4 = (L, H, H, L)$, $\varsigma_5 = (L, H, L, H)$ and $\varsigma_6 = (L, L, H, H)$, according to prior probability distribution $\Pi(\varsigma)$ which assigns probability 1/6 to the draw of every vector.

2. At $t = 1$, Nature reveals τ_i, $\tau = H, L$, to entrepreneur i, $i = 1, 2, 3, 4$ but not to any other entrepreneur nor to the microlender.

3. At $t = 2$, the microlender proposes the above triple of lending schemes.

4. At $t = 3$, the entrepreneurs, after observing the menu of contracts, decide simultaneously whether to perform individually the project or to constitute production teams.

5. At $t = 4$ the single entrepreneurs and/or the teams, who have no time preference, decide whether to accept one of the proposed lending schemes, in which case they obtain funds and invest, or not to apply.

6. At $t = 5$, output is produced: the single entrepreneurs and/or the teams repay according to the contractual scheme they accept at $t = 4$.

We analyze the simultaneous Bayesian game among entrepreneurs at $t = 3$ by restricting our attention to pure-strategy Bayesian Equilibria (BE). Each entrepreneur selects an action from the set $A^E = \{S, T\}$, where S indicates the choice of performing singularly the project and T the choice of building a team. When choosing S a player knows only her type and her interim beliefs about the type of any other player are computed using Bayes' rule: $\pi_i(\tau_{-i} = \tau_i | \tau_i) = 1/3$ and $\pi_i(\tau_{-i} \neq \tau_i | \tau_i) = 2/3$. When choosing T, instead, she knows perfectly the others' type. Prior beliefs of the microlender about the entrepreneurs' type also derive from Bayes' rule: $\pi_m(H) = \pi_m(L) = 1/2$, where subscript m stands for microlender.

There are $2^N = 2^4$ possible combinations of actions. We design game's outcomes as follows.

If at least three entrepreneurs play S, the outcome of game is assumed to be "all entrepreneurs stay alone". Indeed, if at most one player decides to form a team, she is not able to find a partner, thereby being forced to perform individually her project. In this case, the microlender implements IL.

If, instead, none plays S, then the outcome of game is "two teams are built" and the microlender executes PTL.

If, finally, one or two players select S, then the outcome of game is "one team is built and two entrepreneurs stay alone", in which case the microlender fulfills ML.

5 Individual Lending

We begin the analysis of lending schemes from the case where at $t = 3$ three or four entrepreneurs choose to perform individually the project, hence IL will be implemented by the microlender. Since the entrepreneurs are not endowed with assets to be put up as collateral, the microlender proposes a financial contract in which the following limited liability constraint is specified: when the project succeeds the entrepreneurs have to repay an amount R_τ, $\tau = H, L$, that cannot exceed the realized returns, whereas if returns are zero nothing is repaid. Without loss of generality we can design IL as follows. The microlender chooses R_τ so as to maximize total profits of the entrepreneurs for he represents a not-for-profit organization, provided that his participation constraint and the entrepreneurs' limited liability and incentive compatibility constraints are satisfied:[6]

$$\max_{R_H, R_L} 2(A - R_H) + 2p(A - R_L) \tag{1}$$

s.t.

$$2R_H + 2pR_L \geq 4\rho,$$

$$R_\tau \leq A,$$

$$A - R_H \geq A - R_L, \tag{IC_H}$$

$$p(A - R_L) \geq p(A - R_H), \tag{IC_L}$$

where $IC_{H(L)}$ is the incentive compatibility constraint of type $H(L)$. Solution to the above program is pooling:

$$R^* = R_H = R_L = \frac{\rho}{p_M}, \tag{2}$$

where $p_M = (1 + p)/2$ is the average probability of repaying, computed by taking into account microlender's prior beliefs, which he is not able to update: $\pi_m(H) = \pi_m(L) = 1/2$. If this contract is accepted, type H entrepreneurs end up with

$$A - R^* = A - \frac{\rho}{p_M} \tag{3}$$

and type L with

$$p(A - R^*) = p\left(A - \frac{\rho}{p_M}\right). \tag{4}$$

The microlender gets his reservation value:

$$(2 + 2p) R^* = 4\rho. \tag{5}$$

Bad borrowers, who repay with probability p, are charged a lower interest rate than the one they would pay with symmetric information, as good borrowers produce an effect of cross-subsidization.

[6] Remark that entrepreneurs' participation is implied by limited liability.

6 Production Team Lending

Consider now the case where at $t = 3$ all entrepreneurs decide to build teams. As anticipated above, the microlender implements PTL, which consists of a pair of screening contracts.

The first contract requires the teams to adopt a technology for which expected output of a team with n_H type H entrepreneurs plus $n_L = 2 - n_H$ type L ones is

$$q\left(n_H, n_L\right) 2A + \left(1 - q\left(n_H, n_L\right)\right) 0. \tag{6}$$

Let the probability of success $0 < q\left(n_H, n_L\right) \leq 1$ be increasing in n_H (and decreasing in $n_L = 2 - n_H$) and $q\left(2, 0\right) = 1$. Moreover, let

$$\frac{\partial^2 q\left(n_H, n_L\right)}{\partial^2 n_H} > 0: \tag{7}$$

the probability of success $q\left(n_H, n_L\right)$ is increasing and convex in n_H. We refer to this technology as technology A (henceforth AT). The first contract also specifies limited liability and a repayment $2R_{AT} \leq 2A$ due by the team as a whole only in the case of success. We denote this contract with $\{AT, 2R_{AT}\}$. An appropriate example of AT is the O-ring technology (Kremer, 1993), where whole team fails if at least one member fails, i.e. $q\left(n_H, n_L\right) = 1^{n_H} q^{n_L} = q^{2-n_H}$.

The second contract prescribes the use of a technology which produces the following expected output:

$$r\left(n_H, n_L\right) 2A + \left(1 - r\left(n_H, n_L\right)\right) 0, \tag{8}$$

where, again, $0 < r\left(n_H, n_L\right) \leq 1$ is increasing in n_H (and decreasing in $n_L = 2 - n_H$) and $r\left(2, 0\right) = 1$. Furthermore, let

$$0 < q\left(0, 2\right) < r\left(0, 2\right) \tag{9}$$

and

$$\frac{\partial^2 r\left(n_H, n_L\right)}{\partial^2 n_H} = 0: \tag{10}$$

expected output is lower with AT if both members are bad and the probability of success $r\left(n_H, n_L\right)$ is linearly increasing in n_H. This technology is denoted with B (henceforth BT). The second contract also specifies limited liability and a repayment $2R_{BT} \leq 2A$ due by the team as a whole only in the case of success. We indicate this contract with $\{BT, 2R_{BT}\}$.

Assumption 1 $r\left(0, 2\right) = p$.

The only example of BT which satisfies all the above requirements is a technology where the probability of success is equal to the mean probability, i.e. $r\left(n_H, n_L\right) = \left(n_H + pn_L\right)/2$.

When all entrepreneurs choose to constitute teams, the deriving self-selection process is driven by PTL: we study its outcome in the next subsection.

6.1 Team formation and Peer Selection

We verify that entrepreneurs choose partners of the same type when contract $\{AT, 2R_{AT}\}$ is chosen (this is called peer selection), while team formation may display different characteristics when contract $\{BT, 2R_{BT}\}$ is selected.

Recalling expression (6) and the fact that repayment $2R_{AT}$ is due only in the case of success, we can write the expected profit of a team which chooses contract $\{AT, 2R_{AT}\}$ and counts n_H type H entrepreneurs plus $n_L = 2 - n_H$ type L ones:

$$q(n_H, n_L)\, 2(A - R_{AT}). \tag{11}$$

By assumption $q(2,0)$ is equal to 1, so that (11) is maximum when $n_H = 2$ and $n_L = 0$: this means that types H are preferred for they increase the probability of success. It follows that type H entrepreneurs will build teams among them, while bad entrepreneurs will try to attract preferred types H.

We check whether an equilibrium where teams consist of either all good or all bad entrepreneurs is robust to bilateral deviations, where (i) a type L tries to take the place of a type H by making transfers to her, which must at least equalize loss of the good entrepreneur from joining a team with a bad mate, (ii) the other two entrepreneurs (i.e. type H and type L who do not change team) are not allowed to make transfers.[7] We suppose each entrepreneur, when forming a team, is entitled to an amount 1/2 of total output.

If a type L takes the place of a type H in a team made of all good entrepreneurs, her gain is given by the difference between bad entrepreneur's expected profit when she teams up with a good mate, i.e.

$$\frac{1}{2} q(1,1)\, 2(A - R_{AT}), \tag{12}$$

and the corresponding value when the mate is bad, i.e.

$$\frac{1}{2} q(0,2)\, 2(A - R_{AT}): \tag{13}$$

we get

$$[q(1,1) - q(0,2)](A - R_{AT}), \tag{14}$$

where $q(1,1) - q(0,2)$ is the increased probability of success. Similarly, we can compute the loss of a good entrepreneur from joining the team with the type L:

$$[1 - q(1,1)](A - R_{AT}), \tag{15}$$

where $1 - q(1,1)$ is the decreased probability of success. Note that condition (7) implies

$$q(1,1) - q(0,2) < 1 - q(1,1), \tag{16}$$

[7] Such transfers are not monetary because entrepreneurs are wealthless. They rather consist, for example, of providing free labor services.

which is equivalent to state that (14) < (15). It follows that a type L entrepreneur cannot compensate a good one with a side transfer to take her place in a team of all good entrepreneurs and simultaneously end up with a positive return. This condition is sufficient to conclude that teams arise with either all good or all bad entrepreneurs if contract $\{AT, 2R_{AT}\}$ is proposed and accepted. The former ends up with $A - R_{AT}$, whereas the latter gets $q(0,2)(A - R_{AT})$. The intuition of this result is as follows: good entrepreneurs value good mates more than bad entrepreneurs because marginal contribution of a type H to the success probability is increasing in the number of good entrepreneurs already present in the team but decreasing in the number of bad mates.[8]

When contract $\{BT, 2R_{BT}\}$ is selected, peer selection in team formation may not occur. Following the above reasoning, we compute gain of a bad entrepreneur from leaving a team with a peer and joining a team with a mate of the other type and loss of a good entrepreneur from following the opposite path. The former value is

$$[r(1,1) - r(0,2)](A - R_{BT}). \tag{17}$$

Similarly, loss of a good entrepreneur from joining a bad partner is

$$[1 - r(1,1)](A - R_{BT}), \tag{18}$$

BT satisfies condition (10) which implies

$$r(1,1) - r(0,2) = 1 - r(1,1). \tag{19}$$

This is equivalent to state that (17) = (18): in this case a type L entrepreneur can compensate a good one with a side transfer to take her place in the team with a type H mate and simultaneously end up with a nonnegative return.[9] With BT good entrepreneurs do not value good mates more than bad entrepreneurs because marginal contribution of a type H to the success probability does not depend on the team composition. It turns out that, if (17) is transferred from the type L to the type H, both entrepreneurs are indifferent between matching with a peer or shifting their respective places. We suppose that peer selection occurs, in which case both types H end up with $A - R_{BT}$ and both types L with $r(0,2)(A - R_{BT}) = p(A - R_{BT})$.

[8] Peer selection arises even when entrepreneurs who do not switch team are able to make transfers among them. In such a case inequality (14) < (15) rewrites simply as

$$2[p(1,1) - p(0,2)](A - R_{AT}) < 2(1 - p(1,1))(A - R_{AT}), \tag{a}$$

where: the LHS is the sum of gain of the type L who joins a good entrepreneur and gain of the other type L who does not change team but welcomes a good mate; the RHS is the corresponding sum of loss of type H who switches team and loss of the other type H who saddle herself with a bad partner. It is immediate to check that inequality (a) still holds under condition (7).

[9] As shown in Note 6, one can verify that this result extends to the case where also entrepreneurs who do not switch team are allowed to make transfers.

6.2 Screening Contracts with Production Team Lending

We show how the microlender is able, by means of PTL, to screen between good and bad entrepreneurs.

The microlender foresees that the expected profit of good entrepreneurs is $(A - R_{AT})$ if they accept $\{AT, 2R_{AT}\}$ and $(A - R_{BT})$ if they accept $\{BT, 2R_{BT}\}$. If the following condition holds

$$A - R_{AT} \geq A - R_{BT}, \tag{20}$$

the microlender anticipates correctly that both good entrepreneurs will select the contract $\{AT, 2R_{AT}\}$, thereby matching among them, and that bad entrepreneurs will have no choice but to constitute a team with a peer. Bad entrepreneurs will therefore accept contract $\{BT, 2R_{BT}\}$ when

$$p\,(A - R_{BT}) \geq q\,(0,2)\,(A - R_{AT})\,, \tag{21}$$

where the two sides of the above inequality represent the expected profits of bad entrepreneurs if they accept either $\{BT, 2R_{BT}\}$ or $\{AT, 2R_{AT}\}$, respectively.[10] The expression below summarizes the incentive compatibility constraints (20) and (21):

$$R_{AT} \leq R_{BT} \leq \frac{[(p - q\,(0,2))]\,A + q\,(0,2)\,R_{AT}}{p}. \tag{22}$$

Condition (9), Assumption 1 and the limited liability constraint imply that the above interval is nonempty.

With no loss of generality, the PTL can be summarized as follows: the microlender sets R_{BT} to maximize profits of bad entrepreneurs on contract $\{BT, 2R_{BT}\}$, subject to his participation constraint, to zero-profit condition on contract $\{AT, 2R_{AT}\}$, to limited liability and, finally, to (22). In symbols

$$\begin{aligned}
&\max_{R_{BT}} 2p\,(A - R_{BT}) \\
&\text{s.t.} \\
&2pR_{BT} \geq 2\rho \\
&2R_{AT} = 2\rho, \\
&4R_j \leq 4A, \\
&R_{AT} \leq R_{BT} \leq \frac{[p - q\,(0,2)]\,A + q\,(0,2)\,R_{AT}}{p},
\end{aligned} \tag{23}$$

where $j = AT$, BT. Taking into account that zero-profit condition on contract

[10] If the choice of technology is observed after the contract is signed, then the inequality (21) can be rewritten as $p\,(A - R_{BT}) \geq p\,(A - R_{AT}) - F$, where F could be a fine charged to the bad entrepreneurs when they adopt technology B after selecting contract $\{AT, 2R_{AT}\}$.

$\{AT, 2R_{AT}\}$ gives $R^*_{AT} = \rho$, (23) can be rewritten as

$$\max_{R_{BT}} 2p\,(A - R_{BT}) \tag{24}$$

s.t.

$$\frac{\rho}{p} \leq R_{BT} \leq \frac{[p - q\,(0,2)]\,A + q\,(0,2)\,\rho}{p}.$$

If

$$\frac{\rho}{p} \leq \frac{[p - q\,(0,2)]\,A + q\,(0,2)\,\rho}{p} \Leftrightarrow \frac{1 - q\,(0,2)}{p - q\,(0,2)}\rho \leq A, \tag{25}$$

the solution to (24) is $R^*_{BT} = \frac{\rho}{p}$. Good entrepreneurs end up with

$$A - R^*_{AT} = A - \rho \tag{26}$$

and bad ones with

$$p\,(A - R^*_{BT}) = pA - \rho. \tag{27}$$

The microlender obtains his reservation profit:

$$2R^*_{AT} + 2pR^*_{BT} = 4\rho. \tag{28}$$

The entrepreneurs self-select among peers if AT is adopted. This enables the microlender to screen between good and bad clients if he implements PTL. Indeed, good entrepreneurs succeed with certainty under both technologies, thereby choosing contract $\{AT, 2R_{AT}\}$ because $R^*_{AT} < R^*_{BT}$. Instead, bad entrepreneurs prefer BT even if the associated repayment is higher, because

$$q\,(0,2)\,(A - R^*_{AT}) \leq p\,(A - R^*_{BT}): \tag{29}$$

they fail more often with AT.[11]

7 Mixed Lending

Suppose now that at $t = 3$ one or two entrepreneurs select S: the outcome of game is then "one team is built and two entrepreneurs stay alone" and the microlender fulfills ML, which consists of a pair of contracts. The first one is addressed to the team and requires it to adopt a technology for which expected output of a team with n_H type H entrepreneurs plus $n_L = 2 - n_H$ type L ones is

$$s\,(n_H, n_L)\,2A, \tag{30}$$

[11] It is easy to check that PTL produces screening even when peer selection does not occur with BT.

where

$$s(n_H, n_L) = \alpha q(n_H, n_L) + (1-\alpha) r(n_H, n_L) \text{ and } \alpha \in (0,1). \tag{31}$$

This technology consists of a linear combination of AT and BT and is denominated mixed technology (MT). The contract also contains a repayment $2R_{MT} \leq 2A$ due by the team as a whole only in the case of success. We indicate this contract with $\{MT, 2R_{MT}\}$. The second contract, $\{R_1\}$, is designed to suit the single entrepreneurs and specifies a repayment $R_1 \leq A$ due by them only whether successful.

Conditions (7), (10) and definition (31) are sufficient to have peer selection when contract $\{MT, 2R_{MT}\}$ is selected. It follows that type H entrepreneurs end up with $(A - R_{MT})$, when selecting $\{MT, 2R_{MT}\}$, and with $(A - R_1)$, when choosing $\{R_1\}$. Instead, type L entrepreneurs get $s(0,2)(A - R_{MT})$ and $p(A - R_1)$, respectively. Good entrepreneurs will hence choose $\{MT, 2R_{MT}\}$ and bad ones $\{R_1\}$ if

$$\begin{cases} A - R_{MT} \geq A - R_1, \\ p(A - R_1) \geq s(0,2)(A - R_{MT}). \end{cases} \tag{32}$$

The two incentive compatibility constraints are summarized by the expression below:

$$R_{MT} \leq R_1 \leq \frac{[p - s(0,2)]A + s(0,2) R_{AT}}{p}. \tag{33}$$

ML is designed as follows: the microlender sets R_1 to maximize profits of bad single entrepreneurs on contract $\{R_1\}$, subject to his participation constraint, to zero-profit condition on contract $\{MT, 2R_{MT}\}$, to limited liability and, finally, to (33). In symbols

$$\max_{R_{BT}} 2p(A - R_1) \tag{34}$$

s.t.

$$2pR_1 \geq 2\rho$$

$$2R_{MT} = 2\rho,$$

$$2R_{MT} \leq 2A,$$

$$R_1 \leq A,$$

$$R_{MT} \leq R_1 \leq \frac{[p - s(0,2)]A + s(0,2) R_{MT}}{p}.$$

Assumption 2 $\frac{1-s(0,2)}{p-s(0,2)}\rho \leq A.$

Assumption 2, which is equivalent to $\frac{\rho}{p} \leq \frac{[p-s(0,2)]A+s(0,2)\rho}{p}$, states that output A is big relatively to opportunity cost of capital ρ. Solution to program (34) is then separating:

$$R^*_{MT} = \rho,\ R^*_1 = \frac{\rho}{p}. \tag{35}$$

With ML the microlender is able again to produce screening between good and bad borrowers: the reasoning is as in the previous section. If these contracts are selected, type H entrepreneurs end up with

$$A - R^*_{MT} = A - \rho \tag{36}$$

and type L ones with

$$p\,(A - R^*_1) = pA - \rho. \tag{37}$$

Notice that Assumption 2 implies $pA > \rho$: this signifies that projects of both types are socially profitable because their expected output is higher than the sum of reservation profits. It also means that condition (25) cannot hold as an equality, with the effect that condition (29) rewrites as $q\,(0,2)\,(A - R^*_{AT}) < p\,(A - R^*_{BT})$. The microlender obtains his reservation profit:

$$2R^*_{MT} + 2pR^*_1 = 4\rho. \tag{38}$$

8 Equilibrium

In this section we solve the static Bayesian game played by the entrepreneurs at $t = 3$. We check whether the following four combinations of pure strategies are determined by BE of the game: $(TTTS)$, $(TTST)$, $(TTSS)$ and $(TTTT)$, where, for ease of exposition but with no loss of generality, the order of players is supposed to be $HHLL$, i.e. the first two players are type H and the last two ones are type L.

Before proceeding, it is important to remark that uncertainty about players' type does not play any role in determining players' payoff. Indeed, we suppose that an entrepreneur has incomplete information only if she plays S. Yet, in such a case just two lending schemes may be implemented, either ML or IL, with the effect that type τ entrepreneur when selecting S gets either $p_\tau\,(A - \rho/p)$ or $p_\tau\,(A - \rho/p_M)$, respectively, for any belief about the others' type.

First consider $(TTTS)$ and $(TTST)$. When one of these two combinations are played, the outcome of game is "one team (with two type H entrepreneurs) is built and two (type L) entrepreneurs stay alone" (see Subsection 4.1). In this case, entrepreneurs anticipate that ML will be implemented: each type H (resp. L) ends up with $A - \rho$ (resp. $pA - \rho$) (see Section 7). We check whether these combinations are robust to deviations by any player. The only deviation available for a type H is playing S, in which case she anticipates that ML will be implemented and that $R^*_1 = \rho/p$ is the repayment charged to single entrepreneurs: H gets $A - \rho/p$ which is strictly lower than $A - \rho$. We can conclude that no profitable deviations are available for type H. Focus now on type L playing T at equilibrium. If she deviates, i.e. she plays S, again ML is implemented so that she ends up with $pA - \rho$. If type L playing S deviates, i.e. she plays T, then PTL is implemented and she ends up with $pA - \rho$ (see

Subsection 6.2). We can conclude that no strictly profitable deviations are available for type L: $(TTTS)$ and $(TTST)$ are determined by BE of the game.

We now take into account combination $(TTSS)$ for which the outcome of game is "one team (with two type H entrepreneurs) is built and two (type L) entrepreneurs stay alone", ML is implemented and each type H (resp. L) obtains $A - \rho$ (resp. $pA - \rho$). If any type H deviates by selecting S, then the outcome of game is "all entrepreneurs stay alone" and IL will be implemented. Type H ends up with $A - \rho/p_M$ which is strictly lower than $A - \rho$: no profitable deviations are available for type H. Similarly, if any type L deviates by playing T, ML is still implemented and type L gets $pA - \rho$: no strictly profitable deviations are available for type L. Also $(TTSS)$ is determined by BE.

Finally, consider combination $(TTTT)$ for which the outcome of game is "two teams are built", PTL is implemented and each type H (resp. L) obtains $A - \rho$ (resp. $pA - \rho$). If any type H deviates by selecting S, the outcome of game is "one team is built and two entrepreneurs stay alone", ML is implemented and type H obtains $A - \rho/p$ which is strictly lower than $A - \rho$: no profitable deviations are available for type H. At the same time, if any type L deviates by playing S, ML is implemented and type L gets $pA - \rho$: no strictly profitable deviations are available for type L. Also $(TTTT)$ is determined by BE.[12]

Summing up, four combinations of pure strategies are determined by BE of the game: $(TTTS)$, $(TTST)$, $(TTSS)$ and $(TTTT)$, where recall that the order of players is supposed to be $HHLL$. We therefore can conclude that the equilibrium outcomes of the game are: (i) one team with two type H entrepreneurs is built and type L entrepreneurs stay alone; (ii) two teams are built between peers. In both cases the microlender ends up with his reservation profit.

We summarize these findings in the following

Proposition 1 *Under Assumptions 1 and 2, two outcomes of the game played by the entrepreneurs at* $t = 3$ *are determined by pure-strategy BE: (i) the two good entrepreneurs choose to build a team by adopting mixed technology and they repay with probability* 1*, while the bad ones stay alone and repay with probability* $p < 1$*; (ii) both good entrepreneurs form a team which adopts technology* A *and repays with probability* 1*, whereas both bad ones build a team by selecting technology* B *and repay with probability* $p < 1$*. The microlender always gets his reservation profit.*

Forming a team between good peers enables the microlender to implement screening mechanisms (either ML or PTL). The deriving disclosure of information makes the microlender able to reduce the repayment charged to type H entrepreneurs. In such a case the bad entrepreneurs are no more cross-subsidized by the good ones, thereby being indifferent, under Assumption 1, between staying alone or building a team with BT.

[12] It is possible to check the no other combination of actions can be supported by a pure-strategy BE.

Our results suggest that targeting teams with high degree of complementarity among tasks (i.e. teams that choose either AT or MT) is a good lending strategy when no collateral is required, and, as it occurs in urban areas, networks of local information and social capital are weak. Such teams repay with higher probability because each member has strong incentive to look for good mates, so as to maximize the revenues.

Identifying teams that adopt AT (resp. BT, resp. MT) as cooperatives (resp. associations, resp. pool of cooperatives and associations) enables us to interpret the MAGs data on the basis of peer selection and screening mechanisms. Indeed, the first equilibrium outcome displays the situation described by Table 1, where the set of cooperatives and associations, i.e. teams with MT that count only good entrepreneurs, turns out to be less risky than single entrepreneurs, who are type L, and allows the microlender to charge a lower interest rate to the former. The second equilibrium outcome explains the data contained in Table 2, where cooperatives, teams with AT that consist of good entrepreneurs, are better clients than associations, teams with BT made by bad entrepreneurs.

9 Conclusion

Poor local information networks and weak social sanctions in urban developed areas make joint liability unable to guarantee high repayment rates to microlenders. Yet, microcredit programmes in Western Europe report a good degree of financial self-sufficiency, according to NEF and Viganò, even if the majority of them requests no collateral.

This paper proposes an alternative microcredit instrument that, like joint liability, is able to mitigate informational problems in microcredit markets, but fit the urban context, where social sanctions are too weak to serve the role of collateral substitutes.

The analysis on loans granted by MAG2 Milano, MAG4 Torino and MAG6 Reggio Emilia reveals that (i) teams (cooperatives and associations) repay more often than individual entrepreneurs and, between teams, (ii) cooperatives are less risky than associations. On this basis, we develop a model where two types of wealthless entrepreneurs, who differs in their ability of producing output, decide, before applying for loans, whether (1) to perform singularly the project, or (2) to build production teams. Loans consist of different lending schemes a microlender commits to implementing conditional on the entrepreneurs' choice between alternatives (1) or (2).

Two equilibrium scenarios arise: (i) only good entrepreneurs constitute teams, whereas bad ones choose to stay alone; (ii) all entrepreneurs build teams, but good ones self-select among peers and adopt a technology with higher degree of complementarity among contributions of each member, while bad ones constitute teams among them and employ a technology with a lower level of complementarity.

Our findings suggest that targeting teams with high degree of complementarity among tasks is a good lending strategy when no collateral is put up and social capital is weak. If we interpret teams that adopt AT (resp. BT) as cooperatives (resp. associations), then the data seem to confirm that the MAGs follow this strategy: they set aside almost half of the loans to cooperatives, whereas only 33% is granted to associations and 18% to single entrepreneurs. The above interpretation also permits us to give a possible explanation, based on peer selection and screening mechanisms, of the evidence that, at least among MAGs' clients, teams, generally, and cooperatives, more specifically, are better entrepreneurs.

While the joint liability practice emphasizes social liaisons among entrepreneurs of the same group, our schemes attract persons who desire to work at the same project: their links have mainly technological and pecuniary nature. We believe that this aspect may overcome problems of poor informational networks and weak social ties, thereby making such an instrument more suitable to the needs of microlenders and entrepreneurs who populate urban areas.

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