Profit-maximizing Behavior Replaces Social Sanctions in Urban Microcredit Markets: the Case of Italian MAGs

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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 charges 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 (associations and cooperatives) 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, mitigates informational problems 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 capital.*

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I. Introduction

Microcredit programmes provide financial services to small-scale entrepreneurs who otherwise lack access to capital markets because they are 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 banks. 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 hidden information problems, inter alia, without requesting any pecuniary collateral (for exhaustive surveys see, e.g. Ghatak and Guinnane, 1999, and Fedele, 2006).

Joint liability works as follows: entrepreneurs, who differ in their ability to repay 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 rise with respect to lending to individuals when no ex-ante collateral is put up (Ghatak, 1999, 2000, Van Tassel, 1999; see also Guttman, 2008, who extends the peer selection result by incorporating dynamic incentives). 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 (2004) and Viganò et al. (2004) (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 (2000) 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, 1999, Ciravegna 2006; see also Gross and de Silva, 2002, for an empirical study of a microcredit project in Albania, both rural and urban: they observe that only the rural methodology is based on group lending contracts).[1]

Interestingly, the institutions surveyed by NEF and Viganò declare an average repayment rate of 90.3%, which is high, even if the majority of them charges neither joint liability *nor* collateral.[2] Yet, the two reports do not mention whether alternative lending schemes help to maintain such positive results.[3]

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 make individual loans without requesting collateral; MAG2 and MAG6 target two main categories of entrepreneurs, single entrepreneurs and teams (associations and cooperatives), whereas MAG4 focuses on teams. Data on repayment rates reveal that teams are less risky than single entrepreneurs.

In order to develop 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 hidden information à la De Meza and Webb (1987) and Laffont and N'Guessan (2000). 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 the project individually, or (2) to be disposed to constitute production teams, whose size is exogenously fixed by the financial agreement. The entrepreneurs knows only their own type: they live in cities where people do not know each other.

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 implements conditional on the entrepreneurs' choice between alternatives (1) or (2).[4]

If all entrepreneurs end up by carrying out the project singularly, the microlender grants individual loans: we call this mechanism Individual Lending scheme. If, instead, all entrepreneurs are disposed to build teams, a screening mechanism, which consists of two contracts addressed to the teams and is named Production Team Lending scheme, is proposed. The first contract contains a certain repayment and requires each team to adopt a technology A, for which expected output is increasing 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 again increasing in the number of good members, but higher than expected output with technology A when all members are bad and equal to when all members are good. Good entrepreneurs prefer the first contract for the associated repayment is lower; bad entrepreneurs, who get lower expected output when employing technology A, prefer the second contract even if it entails a higher repayment. This enables the microlender to discriminate between good and bad entrepreneurs and overcome the informational

[1] 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 underdeveloped countries where the main force leading to the successful repayment of microloans is the strong social network (Anderloni, 2003; ILO, 2002).

[2] See Kugler and Oppes (2005) for a discussion, both theoretical and empirical, 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.

[3] Armendáriz and Morduch (2000, 2003) and Tedeschi (2006), *inter alii*, 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., 2006, 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.

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

problem.

Technologies A and B can be interpreted as two different ways of organizing tasks within each team, the first one penalizing bad entrepreneurs. Such different ways do not necessarily depend on the industry the teams decide to enter. An appropriate, but not unique, example of technology that penalizes bad entrepreneurs may be the O-ring technology (Kremer, 1993), for which whole team fails if at least one member fails. This technology requires expected output to be increasing and convex in the number of good members, thereby describing sophisticated multitasking production processes, for which mistakes in any of the tasks can dramatically reduce the output's value. On the contrary, a technology with success probability linearly increasing in the number of good members represents less sophisticated processes and can be a proper example of Technology B.

When, finally, some entrepreneurs are disposed to form teams and others perform the project individually, lending mechanism is called Mixed Lending and consists of a different pair of contracts. The first one is addressed to the teams: it contains a repayment and requires the teams to adopt technology B. The second contract is designed for single entrepreneurs and specifies a higher repayment due by them only if successful. We show that, also in this case, the microlender discriminates between good entrepreneurs, who select the first contract, and bad ones, who prefer the second contract.

We solve the two-stage Bayesian game played by the entrepreneurs when they first choose between alternatives (1) or (2) and then select one of the contracts of the lending mechanism proposed by the microlender. We find a pure-strategy Perfect Bayesian Equilibrium where all good entrepreneurs end up by constituting teams among them, while all bad ones stay alone; Mixed Lending is implemented by the microlender, the teams adopt technology B and repay with higher probability than single bad entrepreneurs.

Our results suggest that targeting teams may represent a good microlending strategy in urban areas where no collateral is put up and social sanctions are weak. Indeed, when building production teams entrepreneurs participate in a *common* project and are focused on its success, thereby being likely to join partners with high ability of producing output and to reproduce a cohesion typical of joint liability schemes, but based on a profit-maximizing behavior and not on social capital. 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 3).

Our model also offers a possible explanation of the good performance of teams among MAGs' clients. Data on the businesses performed by associations and cooperatives served by MAGs suggest that they devote themselves mainly to cultural activities, on-the-job training activities, production and sale of biological goods and health, social and insurance services. Accepting the hypothesis that such activities require sophisticated production processes does not seem sensible, hence associations and cooperatives can be properly represented by teams that adopt technology B. In this case the equilibrium scenario explains the empirical finding according to which teams turn out to be less risky than single entrepreneurs, by arguing that the latter counts only good entrepreneurs, while single entrepreneurs are bad and repay with lower probability.

The remainder of the paper is organized as follows. Section II provides further details of NEF and Viganò surveys. In Section III we carry out the analysis of the data. The basic model is laid out in Section IV. Sections V, VI and VII present Individual Lending, Production Team Lending and Mixed Lending schemes, respectively. Section VIII studies the equilibrium and Section IX concludes.

II. 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 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 an average of 90.3%.

III. 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 and have pioneered the development and diffusion of microcredit already from the end of 1970s is MAG (Mutua Autogestita), a national entity divided in six regional groups with offices in Verona, Milano, Torino, Venezia, Reggio Emilia and Roma; 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 nancial 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.

[5]Gonzalez-Vega (1998) defines active poor as those people who, 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.

The analysis of the data available from the three MAGs is based on 399 loans for start-up of business activities. By September 2005 the three MAGs had provided 335 loans to teams and 64 to individuals; 88.7% of the loan contracts were already expired. The majority of loans (84%) are given to teams: this recalls MAG's original objective of financing organizations with strong participation of workers and investors in the business activity. It is worth remarking that MAG2 and MAG6 target both single entrepreneurs and teams, whereas MAG4 focuses only on the latter. We study the difference between loans to single entrepreneurs and to teams (associations and cooperatives) both in terms of average repayment rates and average interest rates. The repayment rate is defined as the amount repaid at time t divided by the amount due at time t. We also test the difference in repayment rates between individuals and teams for statistical significance by means of statistics based on a binomial distribution. We finally compute the average amount of the loans in euros (this statistic was not available for MAG6). Table 1 collects the data on average amounts, interest and repayment rates.

TABLE 1. MAGs Data: Average Repayment and Interest Rates

Single Entrepreneurs

	MAG2	MAG4	MAG6	Total
Observations	46	/	18	64
Amount (€)	4067	/	n.a.	/
Repayment Rate	66.5%	/	65%	66%
Interest Rate	8.9%	/	10.1%	9.3%

Associations

	MAG2	MAG4	MAG6	Total
Observations	89	35	44	168
Amount (€)	11966	29111	n.a.	/
Repayment. Rate	66.8%	92.2%	77.9%	75%
Interest Rate	9.4%	8.5%	10.3%	9.4%

Cooperatives

	MAG2	MAG4	MAG6	Total
Observations	70	91	6	167
Amount (€)	18952	49185	n.a.	/
Repayment Rate	72.8%	88.4%	83.3%	81.7%
Interest Rate	8%	8.6%	9.3%	8.4%

P-Values for the Difference in Repayment Rates between Individuals and Teams

	MAG2	MAG4	MAG6	Total
P	0.33	/	0.98	1.01

Table 1 suggests that lending to teams is unambiguously less risky than lending to individuals. Indeed, since $P < 1.96$ in all cases we cannot reject the null hypothesis: the difference in repayment rates between

individuals and teams is significant. Instead, we find no strong evidence that cooperatives are better clients than associations, even if the total average repayment rate is higher for the former.

Table 2 contains data on the activities performed by associations and cooperatives.[6] Category "Other" contains a huge and heterogeneous set of businesses. Category "Unknown" considers all the teams for which there is no information.

TABLE 2. MAGs DATA: ACTIVITIES PERFORMED BY THE TEAMS

Associations

	MAG2	MAG4	MAG6	Total
Observations	89	35	44	168
Cultural Activities	16.9%	74.3%	34.1%	33.3%
On-the-Job Training	12.4%	0	0	6.5%
Other	34.8%	22.9%	27.3%	30.4%
Unknown	36%	2.9%	38.6%	29.8%

Cooperatives

	MAG2	MAG4	MAG6	Total
Observations	70	91	6	167
Cultural Activities	2.9%	8.8%	0%	6%
On-the-Job Training	4.3%	36.3%	0	21.6%
Other	60%	54.9%	83.3%	58.1%
Unknown	32.9%	0	16.7%	14.4%

The majority of the teams devote themselves to cultural activities, on-the-job training activities and other activities (like health, insurance and social services and production and sale of biological goods).

The remainder of the paper develops the theoretical framework.

IV. THE MODEL

Consider an urban microcredit market with $N = 4$ wealthless risk-neutral entrepreneurs of two different types. There are two type $\tau = H$ entrepreneurs endowed with productive projects which yield A with probability $p_H = 1$. Risky projects of the two type $\tau = L$ entrepreneurs yield A with probability $p_L = p$, $0 < p < 1$, and zero otherwise. Throughout the paper we refer to type $H(L)$ entrepreneurs as good (bad). Each project requires one unit of capital. Money is provided by a risk-neutral microlending institution. 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 carry out the project singularly, or (2) to be disposed to form production teams. Teams must count $n = 2$ members. The entrepreneurs know only their own type; 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.

If an entrepreneur performs the project singularly, as specified above, she needs one unit of capital as financial input: if the entrepreneur is good output is equal to A; if she is bad, expected output is pA. If teams are built, each one needs two units of capital as financial input and expected output depends not only on the entrepreneurs' type, but also on the technology the teams avail themselves of, as we will see below.

After the microlender has observed the entrepreneurs' choice between (1) and (2), he proposes different lending schemes conditional on three possible situations: (a) at most one entrepreneur is disposed to form a team, in which case the microlender implements a mechanism which we refer to as Individual Lending (henceforth $\mathcal{IL}$); (b) the four entrepreneurs are disposed to constitute a team, then the scheme proposed by the microlender is named Production Team Lending (henceforth $\mathcal{PTL}$); two or three entrepreneurs are disposed to build a team, in which case the scheme is called Mixed Lending (henceforth $\mathcal{ML}$). Each scheme consists in a pair of loan contracts: with $\mathcal{IL}$, resp. $\mathcal{PTL}$, both contracts are designed for the single entrepreneurs, resp. teams; with $\mathcal{ML}$ one contract is addressed to the team and the second one to the single entrepreneurs. Detailed features of the three mechanisms are delineated in Sections V, VI and VII.

A. 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 entrepreneurs decide simultaneously whether to carry out the project individually or to be disposed to constitute production teams.
4) At $t = 3$, the microlender proposes one of the three above lending schemes; the entrepreneurs, who have no time preference, decide simultaneously whether to choose one of the two contracts, in

[6] Unfortunately, no data were available on the activities performed by the single entrepreneurs.

which case they obtain funds and invest, or not to apply;

5) At $t = 4$, output is produced: the single entrepreneurs and/or the teams repay according to the contractual scheme they accept at $t = 3$; when teams are formed each member is supposed to be entitled to an amount $1/2$ of team output.

We analyze the two-stage Bayesian game among entrepreneurs at $t = 2, 3$ by restricting our attention to pure-strategy Perfect Bayesian Equilibria (PBE).[7] At $t = 2$ any entrepreneur i selects an action from the set $\mathcal{A} = \{S, T\}$, where S indicates performing the project singularly and T being disposed to build a team. Entrepreneur i knows only her type and her interim beliefs about the type of any entrepreneur $-i$ are computed using Bayes' rule: $\pi_i(\tau_{-i} = \tau_i | \tau_i) = 1/3$ and $\pi_i(\tau_{-i} \neq \tau_i | \tau_i) = 2/3$. Prior beliefs of the microlender about entrepreneur i's type also derive from Bayes' rule: $\pi_m(\tau_i = H) = \pi_m(\tau_i = L) = 1/2$, where subscript m stands for microlender.

There are 2^N possible combinations of the first-stage actions, whose outcome is defined only when at most one entrepreneur plays T: in this case all entrepreneurs end up by staying alone and the microlender offers $\mathcal{IL}$. Indeed, if only one entrepreneur decides to form a team, she is not able to find a partner.

At $t = 3$ the microlender and the entrepreneurs observe the first-stage actions. For simplicity we neglect entrepreneurs's admissible choice of refusing both contracts of any scheme: as we will see below, entrepreneurs' participation is implied by a limited liability constraint contained in all the contracts.

When $\mathcal{IL}$ is proposed by the microlender, at $t = 3$ any entrepreneur i chooses an action from the set $\mathcal{C}_{IL} = \{\mathcal{R}_{IL_1}, \mathcal{R}_{IL_2}\}$, where IL_1, resp. IL_2, denotes $\mathcal{IL}$'s first, resp. second, contract, and $\mathcal{R}_{IL_1}$, resp. $\mathcal{R}_{IL_2}$, accepting IL_1, resp. IL_2.

Instead, when at $t = 3$ all entrepreneurs play T the microlender executes $\mathcal{PTL}$: any entrepreneur i chooses an action from the set $\mathcal{C}_{PTL} = \{\mathcal{R}_{PTL_A}, \mathcal{R}_{PTL_B}\}$, where PTL_A, resp. PTL_B, denotes $\mathcal{PTL}$'s first, resp. second, contract, and $\mathcal{R}_{PTL_A}$, resp. $\mathcal{R}_{PTL_B}$, accepting PTL_A, resp. PTL_B. There are 2^N possible combinations of actions $\mathcal{R}_{PTL_A}$ and $\mathcal{R}_{PTL_B}$, whose outcome is designed as follows. Two teams are built if (a) all entrepreneurs choose the same contract (either PTL_A or PTL_B); (b) two entrepreneurs choose one contract and the other two the second contract. On the contrary, if three entrepreneurs choose one contract and just one player selects the second, then the latter and one of the other three players are not able to team up for they are opting for different contracts: only one team is built between two over the three entrepreneurs choosing the same financial agreement, while two players get no funding because PTL_A and PTL_B are designed exclusively for teams. All entrepreneurs playing T at $t = 2$ is hence a necessary but not sufficient condition to build two teams.

Finally, when two or three entrepreneurs select T, $\mathcal{ML}$ is offered and the design of the subgame is based on the following hypothesis: if an entrepreneur plays S, resp. T, then for consistency she is not allowed to select a contract designed for teams, resp. singles. In symbols any entrepreneur who plays S, resp. T, at $t = 2$ selects an action from the set $\mathcal{C}_{ML_S} = \{\mathcal{R}_{ML_S}\}$, resp. $\mathcal{C}_{ML_T} = \{\mathcal{R}_{ML_T}\}$, where $\mathcal{R}_{ML_S}$, resp. $\mathcal{R}_{ML_T}$ denotes accepting contract ML_S, resp. ML_T, addressed to the single entrepreneurs, resp. to the team. Yet and again, selecting T is not a sufficient condition to form a team when three entrepreneurs make such a choice; indeed, one of them stays alone because teams must count 2 members. The following scenario may therefore occur: an entrepreneur plays T, but $\mathcal{C}_{ML_T} = \{\varnothing\}$ because contract MLT_T is taken by the other two; if this happens, she is supposed to select an action from the set $\mathcal{C}_{ML_S} \cup \mathcal{C}_{ML_T}$, i.e. she is allowed to perform singularly the project by accepting MLT_S.

The game is solved backwards, by starting from the analysis of the lending schemes at $t = 3$.

V. Individual Lending

Consider the case where at most one entrepreneur plays T at $t = 2$; all entrepreneurs stay alone and the microlender implements $\mathcal{IL}$ at $t = 3$. Since the entrepreneurs are not endowed with assets to be put up as collateral, the pair of loan contracts, one for each type of entrepreneur, proposed by the microlender contains only a price component: when the project succeeds the entrepreneurs have to repay a nonnegative amount $R_\tau \leqslant A$, $\tau = H, L$, whereas if returns are zero nothing is repaid. A limited liability constraint is hence specified.

Without loss of generality we can design $\mathcal{IL}$ as follows. The microlender chooses $IL_1 = \{R_H\}$ and $IL_2 = \{R_L\}$ to maximize total profits of the entrepreneurs for he represents a no-profit organization, provided that his participation constraint and the entrepreneurs' limited liability plus self-selection constraints are satisfied:

$$\max_{R_\tau} \sum_{i=1}^{4} p_{\tau_i} (A - R_{\tau_i}) \tag{1}$$

[7] The microlender is also a player, whose actions consist in constructing the lending schemes. Yet, as we will see below, he designs them so as to minimize his profits: his role simply consists in determining the (maximum) entrepreneurs' payoffs.

$$\text{s.t.}$$

$$\sum_{i=1}^{4} p_{\tau_i} R_{\tau_i} \geqslant 4\rho,$$

$$0 \leqslant R_\tau \leqslant A$$

$$A - R_H \geqslant A - R_L \qquad (IC_H)$$

$$p\left(A - R_L\right) \geqslant p\left(A - R_H\right) \qquad (IC_L)$$

where $IC_{H(L)}$ is the self-selection constraint of type $H(L)$. Remark that entrepreneurs' participation is implied by limited liability for their outside option is zero: this holds throughout the paper.

Lemma 1 *If $\mathcal{IL}$ is implemented, then $IL_1 = IL_2 = \{R^* = \rho/p_M\}$, where $p_M = (1+p)/2$. Type τ entrepreneur accepts contract $\{R^*\}$ and ends up with $p_\tau(A - \rho/p_M)$.*

Solution to (1) is pooling, i.e. the same repayment $R^* = \rho/p_M$ is charged to both types, where p_M is the average probability of success computed by taking into account microlender's prior beliefs, which he is not able to update: $\pi_m(\tau_i = H) = \pi_m(\tau_i = L) = 1/2$. Note that $p < p_M < 1$: bad entrepreneurs, who repay with probability p, are charged a lower interest rate than the one they would pay with symmetric information, as good entrepreneurs produce an effect of cross-subsidization.

VI. Production Team Lending

Consider now the case where all entrepreneurs play T at $t = 2$: one or two teams are built and the microlender implements $\mathcal{PTL}$. The fact that the entrepreneurs are disposed to form teams enables the microlender to add a non-price component to the pair of loan contracts PTL_A and PTL_B; such a component consists of a technology.

Contract PTL_A 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

$$q\left(n_H, n_L\right) 2A + \left[1 - q\left(n_H, n_L\right)\right] 0. \qquad (2)$$

Let the probability of success $q(n_H, n_L)$ be increasing in n_H (and decreasing and in $n_L = 2 - n_H$). We refer to this technology as technology A (henceforth AT). The contract also specifies a nonnegative repayment $2R_{AT} \leqslant 2A$ due by the team as a whole only in the case of success. We denote contract PTL_A with $\{AT, 2R_{AT}\}$.

Contract PTL_B prescribes the use of a technology which produces the following expected output:

$$r\left(n_H, n_L\right) 2A + \left[1 - r\left(n_H, n_L\right)\right] 0. \qquad (3)$$

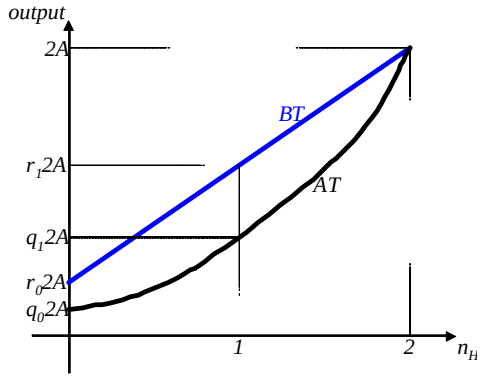
Let the probability of success $r(n_H, n_L)$ be increasing in n_H (and decreasing and in $n_L = 2 - n_H$). This technology is denoted with B (henceforth BT). The contract also specifies a nonnegative repayment $2R_{BT} \leqslant 2A$ due by the team as a whole only in the case of success. We indicate contract PTL_B with $\{BT, 2R_{BT}\}$.

With a slight abuse of notation, let $h(n_H, n_L) = h_{n_H}$, where $h(.) = q(.), r(.)$. Since the probability of success of a good entrepreneur is equal to 1, it seems reasonable to set $q_2 = r_2 = 1$, i.e. the probability of success of a two-good-entrepreneur team is supposed to be equal to 1 for any technology. This hypothesis is not crucial but simplifies computations.

Assumption 1 $0 < q_0 < r_0 < p\left(1 + 2r_1\right) - 2r_1$, $q_1 < r_1$.

Assumption 1 implies $p > r_0$; it hence states that the probability of success of a team with two bad members and AT is positive but lower than the corresponding value when BT is adopted, which in turn is lower than the probability of success of a single bad entrepreneur: AT highly penalizes bad entrepreneurs. Figure 1 depicts Technologies A and B as an O-ring technology (for which expected output is increasing and convex in the number of good members) and a linear one, respectively. According to our assumptions, Technology A can also be linear.[8]

Figure 1. Examples of technologies A and B



Assumption 2 $\max\{\alpha_1, \alpha_2\} \leqslant A/\rho$,

where $\alpha_1 = \left[1 + 2r_1 - r_0\left(1 + 2q_1\right)\right] / \left[2r_0\left(r_1 - q_1\right)\right]$, $\alpha_2 = \left[3 - p\left(1 + 2r_1\right)\right] / \left[p\left(2 - 2r_1\right)\right]$ and

[8] When two entrepreneurs form a team, their contributions are assumed to be perfectly correlated: either the whole project succeeds and A + A is the cash flow, or zero is produced. Technologies A and B differ in the probability of success they assign to the team. We design such a probability in a "flexible" way: for instance, a team made by two bad entrepreneurs produces $2A$ with a probability not necessarily equal to p. This flexibility relies on the idea that the team may perform a production activity which is different from the ones the two entrepreneurs would have implemented if alone.

$\min\{\alpha_1, \alpha_2\} > 1$. Assumption 2 states that output A is big relatively to opportunity cost of capital and implies $pA > \rho$: this means that projects of both types are socially profitable because their expected output is higher than the sum of microlender's and entrepreneurs' reservation profits $\rho + 0$.

We show how the microlender is able to induce the two good, resp. bad, entrepreneurs to choose PTL_A, resp. PTL_B, with the effect that two teams are formed between peers.

When computing expected profit of entrepreneur i who selects PTL_A, resp. PTL_B, two cases must be taken into account: either entrepreneur i does not receive funds (this occurs, for example, when the other three selects PTL_B, resp. PTL_A) or she ends up by forming a team which adopt Technology A, resp. B (this occurs, for example, when the other three selects PTL_A, resp. PTL_B, as well). The first case is trivial as entrepreneur i gets zero for any choice of the contract. We hence focus on the second case. Recalling that each entrepreneur is entitled to an amount $1/2$ of team output, entrepreneur i's expected profit, if $\tau_i = H$, is

$$(A - R_{AT})\left[\pi_i\left(\tau_{-i} = H \,|\tau_i = H\right)1 + \pi_i\left(\tau_{-i} = L \,|\tau_i = H\right)q_1\right] = (A - R_{AT})\left(\frac{1}{3} + \frac{2}{3}q_1\right)$$

when selecting PTL_A. Indeed, according to the interim beliefs, the probability that she teams up with a peer is $1/3$, in which case the team succeeds with probability 1, whereas the mate is type L with probability $2/3$, in which case the team's success probability is q_1. Similarly,

$$(A - R_{BT})\left(\frac{1}{3} + \frac{2}{3}r_1\right)$$

is expected profit of a good entrepreneur when choosing PTL_B and

$$(A - R_{AT})\left(\frac{1}{3}q_0 + \frac{2}{3}q_1\right)$$
$$(A - R_{BT})\left(\frac{1}{3}r_0 + \frac{2}{3}r_1\right)$$

are expected profits of a bad entrepreneur when selecting PTL_A and PTL_B, respectively.

If

$$\begin{cases} (A - R_{AT})\left(\frac{1}{3} + \frac{2}{3}q_1\right) \geqslant (A - R_{BT})\left(\frac{1}{3} + \frac{2}{3}r_1\right), \\ (A - R_{BT})\left(\frac{1}{3}r_0 + \frac{2}{3}r_1\right) \geqslant (A - R_{AT})\left(\frac{1}{3}q_0 + \frac{2}{3}q_1\right), \end{cases} \tag{4}$$

then, from one hand, both good entrepreneur prefer PTL_A; from the other hand both bad ones prefer PTL_B; as a consequence, two teams arise between peers.[9]

If PTL_A and PTL_B satisfy (4), any entrepreneur i and the microlender are thus able to update their beliefs by anticipating correctly that $\tau_{-i} = H$, resp. L, if $-i$ chooses PTL_A, resp. PTL_B. In symbols:

$$\begin{aligned} \pi_i\left(\tau_{-i} = H\,(L)\,|-i \text{ chooses } PTL_A\,(PTL_B)\right) &= 1 \\ \pi_m\left(\tau_{-i} = H\,(L)\,|-i \text{ chooses } PTL_A\,(PTL_B)\right) &= 1 \end{aligned}$$

for any entrepreneur i and the microlender, respectively.

With no loss of generality, $\mathcal{PTL}$ can be summarized as follows. The microlender sets R_{BT} to maximize profits of the two-bad-entrepreneur team on contract PTL_B, subject to his participation constraint, to zero profit condition on contract PTL_A, to limited liability and, finally, to (4):

$$\max_{2R_{BT}} r_0\left(2A - 2R_{BT}\right) \tag{5}$$
$$\text{s.t.}$$
$$r_0 2R_{BT} \geqslant 2\rho,$$
$$2R_{AT} = 2\rho,$$
$$0 \leqslant 2R_j \leqslant 2A,$$
$$\frac{2\left(r_1 - q_1\right)A + \left(1 + 2q_1\right)R_{AT}}{1 + 2r_1} \leqslant R_{BT} \leqslant \frac{\left[r_0 - q_0 + 2\left(r_1 - q_1\right)\right]A + \left(q_0 + 2q_1\right)R_{AT}}{r_0 + 2r_1},$$

where $j = AT, BT$. Taking into account that zero-profit condition on contract PTL_A gives $R^*_{AT} = A$, (5) can be rewritten as

$$\max_{R_{BT}} r_0\left(2A - 2R_{BT}\right) \tag{6}$$
$$\text{s.t.}$$
$$\max\left\{\frac{2\left(r_1 - q_1\right)A + \left(1 + 2q_1\right)\rho}{1 + 2r_1}, \frac{\rho}{r_0}\right\} \leqslant R_{BT} \leqslant \frac{\left[r_0 - q_0 + 2\left(r_1 - q_1\right)\right]A + \left(q_0 + 2q_1\right)\rho}{r_0 + 2r_1}.$$

Under Assumptions 1 and 2 solution to program (6) is separating:

$$2R^*_{AT} = 2\rho < 2R^*_{BT} = 2\frac{2\left(r_1 - q_1\right)A + \left(1 + 2q_1\right)\rho}{1 + 2r_1}.$$

[9]The assumption of contractibility of the technology is not crucial to our analysis. Indeed, remarking that the first inequality of (4) implies $R_{AT} < R_{BT}$ given Assumption 1, (4) could be rewritten as

$$\begin{cases} (A - R_{AT})\left(\frac{1}{3} + \frac{2}{3}q_1\right) \geqslant (A - R_{AT})\left(\frac{1}{3} + \frac{2}{3}r_1\right) - F, \\ (A - R_{BT})\left(\frac{1}{3}r_0 + \frac{2}{3}r_1\right) \geqslant (A - R_{AT})\left(\frac{1}{3}r_0 + \frac{2}{3}r_1\right) - F, \end{cases}$$

if the choice of technology was observed by the microlender only after the contract is signed and F was a fine charged to the teams when they adopt technology B after selecting contract PTL_A.

Lemma 2 *If $\mathcal{PTL}$ is implemented, two teams arise between peers for the two good, resp. the two bad, entrepreneurs select contract $PTL_A = \{AT, 2R^*_{AT}\}$, resp. $PTL_B = \{BT, 2R^*_{BT}\}$. Each good entrepreneur, resp. bad, ends up with $A - \rho$, resp. with $r_0 (1 + 2q_1)(A - \rho)/(1 + 2r_1)$.*

The microlender is able to discriminate between good and bad clients. Indeed, each good entrepreneur chooses contract $PTL_A = \{AT, 2R^*_{AT}\}$ because the difference in the repayments $2R^*_{BT} - 2R^*_{AT} > 0$ is sufficiently high to compensate the lower "interim" probability of success under AT than under BT, i.e. $1/3 + (2/3) q_1 < 1/3 + (2/3) r_1$. Instead, each bad entrepreneur prefers contract $PTL_B = \{BT, 2R^*_{BT}\}$ because even if $2R^*_{BT} > 2R^*_{AT}$, such a difference is sufficiently small to be compensated by the higher "interim" probability of success under BT than under AT, $(1/3) r_0 + (2/3) r_1 > (1/3) q_0 + (2/3) q_1$.

VII. Mixed Lending

Suppose now that at $t = 2$ two or three entrepreneurs select T: one team is built in this case and the microlender offers $\mathcal{ML}$, which consists of a pair of contracts. The first one, $ML_T = \{BT, 2R_{BT'}\}$, is addressed to the team and requires it to adopt technology B for which expected output of a team with n_H type H entrepreneurs plus $n_L = 2 - n_H$ type L ones is described by (3). The contract also contains a nonnegative repayment $2R_{BT'} \leqslant 2A$ due by the team as a whole only in the case of success. The second contract, $ML_S = \{R_1\}$, is designed for the single entrepreneurs and specifies a nonnegative repayment $R_1 \leqslant A$ due by them only whether successful.

We show how the microlender is able to induce the two good, resp. bad, entrepreneurs to choose ML_T, resp. ML_S, with the effect that the team is built between good peers and the two type L entrepreneurs perform the project individually.

If a good entrepreneur gets MLT_T (according to the design of the Mixed Lending subgame, playing T is sufficient to get ML_T only if two entrepreneurs make such a choice), her expected profit is

$$(A - R_{BT'}) [\pi_i (\tau_{-i} = H \,|\tau_i = H)\, 1 + \pi_i (\tau_{-i} = L \,|\tau_i = H)\, r_1] = (A - R_{BT'}) \left(\frac{1}{3} + \frac{2}{3} r_1\right).$$

On the contrary, her profit is $A - R_1$ when getting MLT_S.[10] Corresponding values for a type L are $(A - R_{BT'})((1/3) r_0 + (2/3) r_1)$ and $p(A - R_1)$, respectively.

If

$$\begin{cases} (A - R_{BT'}) \left(\frac{1}{3} + \frac{2}{3} r_1\right) \geqslant A - R_1, \\ p (A - R_1) \geqslant (A - R_{BT'}) \left(\frac{1}{3} r_0 + \frac{2}{3} r_1\right), \end{cases} \tag{7}$$

the two good entrepreneurs select T at $t = 2$ and get ML_T at $t = 3$, whereas choice of each bad one are S and ML_S. As a consequence, the team is built between good peers and the two type L stay alone. If ML_T and ML_S satisfy (7), any entrepreneur i and the microlender are thus able to update their beliefs by anticipating correctly that $\tau_{-i} = H$, resp. L, if $-i$ chooses ML_T, resp. ML_S.

$\mathcal{ML}$ is designed as follows. The microlender sets R_1 to maximize profits of the bad single entrepreneurs on contract ML_S, subject to his participation constraint, to zero profit condition on contract ML_T, to limited liability and, finally, to (7):

$$\max_{R_1} 2p (A - R_1) \tag{8}$$

$$\text{s.t.}$$

$$2pR_1 \geqslant 2\rho,$$

$$2R_{BT'} = 2\rho,$$

$$0 \leqslant 2R_{BT'} \leqslant 2A,$$

$$0 \leqslant R_1 \leqslant A,$$

$$\frac{(2 - 2r_1) A + (1 + 2r_1) R_{BT'}}{3} \leqslant R_1 \leqslant \frac{\left(p - \frac{1}{3} r_0 - \frac{2}{3} r_1\right) A + \left(\frac{1}{3} r_0 + \frac{2}{3} r_1\right) R_{AT}}{p}.$$

Under Assumptions 1 and 2 solution to program (8) is separating:

$$2R^*_{BT'} = 2\rho, R^*_1 = \frac{(2 - 2r_1) A + (1 + 2r_1) \rho}{3},$$

where $R^*_{BT'} < R^*_1$ under Assumption 2.

Lemma 3 *If $\mathcal{ML}$ is implemented, the team arises with the two good entrepreneurs for they both select contract $ML_T = \{BT, 2R^*_{BT'}\}$: each member ends up with $A - \rho$. The two bad entrepreneurs select $ML_S = \{R^*_1\}$ and get $p (1 + 2r_1)(A - \rho)/3$.*

Again the microlender ends up by discriminating between good and bad clients. Indeed, each good entrepreneur chooses contract $ML_T = \{BT, 2R^*_{BT'}\}$ because the disparity in the repayments $R^*_1 - R^*_{BT'} > 0$ is sufficiently high to compensate the difference between the success probability when each entrepreneur stays alone and the "interim" success probability under BT, i.e. $1 > 1/3 + (2/3) r_1$. Instead, the two bad entrepreneur prefers

[10] Playing S is sufficient to get ML_S for any choice of the other entrepreneurs.

contract $ML_S = \{R_1^*\}$ because even if $R_1^* > R_{BT'}^*$, such a difference is sufficiently small to be compensated by the disparity between the success probability when each entrepreneur stays alone and the "interim" success probability under BT, $p > (1/3)\, r_0 + (2/3)\, r_1$.

VIII. Equilibrium

In this section we solve the two-stage Bayesian game played by the entrepreneurs at $t = 2, 3$.

PROPOSITION 1 *Under Assumptions 1 and 2 the two-stage Bayesian game played by the entrepreneurs at $t = 2, 3$ admits the following pure-strategy PBE: at $t = 2$ the two good entrepreneurs play T, while the two bad ones play S; at $t = 3$ the two-good-entrepreneur team adopts technology B and repays with probability 1, while the two single bad entrepreneurs repay with probability $p < 1$.*

PROOF *See the Appendix.*

If good entrepreneurs form a team between them the microlender implements either $\mathcal{ML}$ or $\mathcal{PTL}$, which are both screening mechanisms. The deriving disclosure of information makes him 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 and prefer to stay alone for they would fail more often if they teamed up.

Our results suggest that targeting teams is a good lending strategy when no collateral is required, and, as it occurs in urban areas, networks of local information and social sanctions are weak. Teams repay with higher probability because they are made by good entrepreneurs; this, in turn, is due to the fact that each member has strong incentives to join good mates in order to increase her revenues.

Data contained in Table 2 do not support a clear evidence that associations and cooperatives served by the MAGs perform activities which involve sophisticated production processes. It is hence reasonable to identify them as teams that adopt Technology B. In such a case, the PBE offers an explanation of the Table 1's findings by suggesting that teams turn out to be less risky because they count only good entrepreneurs, while single entrepreneurs are type L.

IX. 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 requires no collateral.

This paper proposes an alternative microcredit instrument that, like joint liability, is able to mitigate informational problems in microcredit markets, but fits 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 teams (associations and cooperatives) repay more often than individual entrepreneurs. On this basis, we develop a model where two types of wealthless entrepreneurs, who differs in their ability to repay, decide, before applying for loans, whether (1) to perform the project singularly, or (2) to be disposed to build production teams. Loans consist of different lending schemes a microlender proposes conditional on the entrepreneurs' choice between alternatives (1) or (2).

At equilibrium only good entrepreneurs constitute teams, whereas bad ones choose to stay alone and repay with lower probability. Our findings suggest that targeting the former is a good lending strategy when no collateral is put up and social sanctions are weak. Since we are able to interpret associations and cooperatives as teams that adopt technology B, then the data seem to confirm that MAGs follow the above strategy: they set aside 84% of the loans to teams, whereas only 16% to single entrepreneurs. Furthermore, we suggest a possible explanation, based on a screening mechanism, of the evidence that, at least among MAGs' clients, teams are less risky than single entrepreneurs.

While the joint liability practice emphasizes social liaisons among entrepreneurs who belong to the same group but perform *different* projects, our instrument attracts persons who desire to work at the *same* project: their cohesion is based on a profit-maximizing behavior. 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.

Possible extensions of the current analysis may include a market with a continuum of entrepreneurs, returns of type H ones which second-order dominate those of type L and teams with size greater than $n = 2$.

X. Appendix

Proof of Proposition 1. We check whether the following profile of pure strategies is PBE of the two-stage

Bayesian game:

$$(T, \mathcal{R}_{ML_T}) \,|\tau_i = H \ , \qquad (9)$$
$$(S, \mathcal{R}_{ML_S}) \,|\tau_i = L \ .$$

The above profile represents a situation where any entrepreneur i chooses (a) T at $t = 2$ and $\mathcal{R}_{ML_T}$ at $t = 3$ if $i = H$, (b) S at $t = 3$ and $\mathcal{R}_{ML_S}$ at $t = 3$ if $i = L$. This means that a two-type H-entrepreneur team is built and the two type L entrepreneurs stay alone: $\mathcal{ML}$ is then implemented and, according to Lemma 3, any entrepreneur i ends up with $(A - \rho)$, resp. $p\,(1 + 2r_1)\,(A - \rho)\,/3$, if $\tau_i = H$, resp. L.

There are $2^2 - 1$ deviations available to any entrepreneur i at $t = 2$. First suppose deviation (T, T) is played, where the first, resp. second, action indicates the one selected by any entrepreneur i when $\tau_i = H$, resp. L. In this case $\mathcal{ML}$ is implemented. If entrepreneur i is type H, a two-type H-entrepreneur team is built and the two type L stay alone. If entrepreneur i is type L, either (i) a two-type H-entrepreneur team is built and the two type L stay alone, or (ii) the team is built between different types, while a type H and a type L stay alone. If

$$2\,(A - R_{BT'})\,(1 - r_1) > (A - R_1)\,(1 - p) \qquad (10)$$

then the sum of entrepreneurs' profits is higher under situation (i). Condition (10) is compatible with our previous assumptions. We hence make a further hypothesis: if the above deviation is played by any entrepreneur i, the microlender denies ML_T to her when $\tau_i = L$, so that the team arises between good peers, which turns out to be efficient if (10) is verified. We can conclude that when deviation (T, T) is played, entrepreneur i gets $(A - \rho)$ when $\tau_i = H$ and $p\,(1 + 2r_1)\,(A - \rho)\,/3$ when $\tau_i = L$.

Consider now deviations (S, T) and (S, S): if entrepreneur i is type H, then all entrepreneurs stay alone, $\mathcal{IL}$ is implemented and entrepreneur i gets $(A - \rho/p_M)$ by selecting $\mathcal{R}_{IL_1 = IL_2}$. If entrepreneur i is type L, then $\mathcal{ML}$ is implemented. According to the above reasoning, one team with two type H entrepreneurs is built and the two type L entrepreneurs stay alone: entrepreneur i gets $p\,(1 + 2r_1)\,(A - \rho)\,/3$.

Notice that all the payoffs from deviations are not higher than the ones obtained by playing (9): since no strictly profitable deviations are available to any entrepreneur i, we can conclude that (9) is a PBE of the game.

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