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Abstract: We analyze the optimal regulation of a MFI that has private information on the intrinsic quality of its loan portfolio (adverse selection) and where the MFI's choice of effort to improve this quality cannot be observed by the regulator (moral hazard). In designing optimal contracts the regulator faces a tradeoff between inducing proper incentives for efficient MFI and costs of regulation in terms of leaving an informational rent for a high quality MFI. We identify conditions for the optimal incentive contract and show that, not surprisingly, these contracts depend on the accuracy of the supervisor's signal, the likelihood of facing a high quality MFI, and the cost of supervision. However, since improving the accuracy of supervision is costly, even in the optimal monitoring scheme there generally exists a positive probability of MFI failure. The content of information disclosure is characterized by the optimal monitoring scheme.

Key Words: Microfinance institution, adverse selection, moral hazard, regulation, supervision, optimal incentive contracts.
JEL Classification: D82, G10, G21, G28

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1. INTRODUCTION

Microfinance, i.e. the provision of financial services to the low-income households and micro and small enterprises (MSEs), provide an enormous potential to support the economic activities of the poor and thus contribute to poverty alleviation.

Widespread experiences and research have shown the importance of savings and credit facilities for the poor and MSEs. This puts emphasis on the sound development of microfinance institutions (MFI) as vital ingredients for investment, employment and economic growth. In the framework of a financial system approach, adequate regulation and supervision of the microfinance industry increasingly move into the centre of attention to ensure the safety of the poor's deposits. The question of the regulation of microfinance is frequently raised in recent years and his news is particularly linked to that of institutionalization of the IMF, which is often highlighted the gaps or the absence of a regulatory framework adapted. A paper recently published in the Microfinance series Consensus Guidelines of the CGAP (Guiding Principles on Regulation and Supervision of Microfinance (2011) has the merit to the point on the state of reflection, lessons from the existing experiences and the degree consensus on the subject, and above all to address the issue of supervision, often at the same time left side and yet essential since it refers to the means to enforce the regulation.

Nowadays, microfinance is demonstrating a great expansion specifically in developing countries. This expansion in scale and services increases the need for regulation and supervision. The concern of the regulatory authority is the security of the people's deposits and the soundness of the financial market.

Generally, the main justifications of regulatory interventions are market imperfections. Concerning the financial market, imperfections are identified by adverse selection and moral hazard behaviour as a result of asymmetric information between the parts. Microfinance institutions and their activities, as a relatively new part of the financial system, represent a set of particular characteristics that enhance the need for regulation and supervision even further.

Interest in the regulation and supervision of MFIs has arisen from their growth and their desire to mobilise deposits. The debate surrounding whether MFIs should be regulated and supervised lies in the belief that through regulation, they will become self-sustainable and achieve massive outreach. Through regulation, MFIs can also be integrated into the formal financial sector. In some developing countries, MFIs have grown to such an extent that the failure of one could result in the loss of confidence in the financial sector, thus attracting regulatory concern.

Regulation is defined by Christen, Lyman and Rosenberg (2003) as "the set of binding rules governing the conduct of legal entities and individuals, whether they are adopted by a legislative body (laws) or an executive body (regulations)". In addition, the government might not be the only possible regulatory institution, denoting with the term also the self-regulation of groups of institutions via associations or networks as well (Chavez and Gonzalez-Vega, 1993).

Although the terms regulation and supervision are sometimes used interchangeably, supervision in contrast, refers to the external oversight aimed at determining and enforcing compliance with regulation, Vogel, Gomez and Fitzgerald (2000). It is implemented through examination practices and monitoring mechanisms which determine the real risks faced by the financial intermediary. Llewellyn (1986) defines supervision as the process of monitoring that institutions are conducting their business either in accordance with regulations or more generally in a prudent manner. Therefore, regulation typically refers to the rules that govern the behaviour financial institutions whereas supervision is the oversight that takes place to ensure that financial institutions comply with those rules. The distinction is important where the regulatory and supervisory functions are split between different agencies as they may have different policy implications.

Before starting the analysis of different issues which are taken into account for implementing a good regulatory structure, it is important to make a distinction between prudential and non prudential regulation. Regulation is prudential when it governs the financial soundness of licensed intermediaries businesses, in order to prevent financial system instability and losses to small, unsophisticated depositors. Although, this paper focuses on prudential regulation, it is important to state that not all regulatory objectives need a prudential treatment. Indeed, non prudential regulatory issues include consumer protection, fraud and financial crime prevention, interest rates policies, permission to land, tax and accounting discipline (Christern, Lyman and Rosenberg, 2003). Non prudential regulation is an accessory to prudential regulation but not less important especially for the Microfinance sector which is very sensible to consumer protection and interest rates policies because it deals generally with low-income people. Prudential regulation is about the safety and soundness of an institution vis-à-vis consumer protection, in that the consumer loses when an institution fails, even if there are no systemic consequences. Prudential regulation focuses on the solvency and safety and soundness of financial institutions (Llewellyn, 1999).

When regulation is discussed in relation to MFIs, it is usually in terms of banking type regulations, what is termed prudential regulation. Although MFIs have different characteristics and risk profiles from traditional formal financial institutions, such as banks, deposit-taking MFIs can be likened most closely to banking institutions.

A current debate in banking regulation centres on the role of information disclosure and the optimal degree of prudential supervision, affecting bank's behaviour and soundness. The intuition behind supervision and public disclosure of information about a bank's riskiness and efficiency is that it may induce depositors to monitor its performance more carefully and thus providing its management with stronger incentives to engage in less risky activities.

Previous research on microfinance regulation and prudential supervision focuses on the relationship between financial performance and regulation, treating outreach as a secondary concern (see Cull, Demirgüç-kunt, and Morduch (2009b)). Ndambu (2011). They have analyzed the impact of regulation on financial intermediaries (including MFIs) worldwide, deriving potential implications of microfinance supervision in a consistent manner and moving one step beyond countries' anecdotal evidence. Hartarska (2005) finds that regulated microfinance institutions in Central and Eastern Europe and the Newly Independent States have lower return on assets relative to others, and weak evidence that the breadth of outreach may be related to regulation. After controlling for the endogeneity of regulation, Hartarska and Nadolnyak (2007) have conducted a research using a positive approach to assess if regulated MFIs achieve better sustainability and outreach than unregulated MFIs. They find that regulation has no impact on financial performance and weak evidence that regulated microfinance institutions serve less poor borrowers. As a policy implication, they concluded that MFIs' transformation into regulated financial intermediaries might not lead to improved financial results and outreach. However, they fund institutions collecting savings reaching more borrowers, thus suggesting that regulation might have an indirect benefit if it is the only way allowing MFIs to collect deposits from the public

In this paper, we analyze the role of prudential supervision and information disclosure as a regulatory instrument, and its effects on the MFI's performance concerning incentives and effort. Here, information disclosure refers to the optimal monitoring scheme by the supervising agency taking into account all costs and benefits of such a scheme.

The theoretical literature on banking (see Freixas and Rochet, 1998, for an excellent survey) has focused on the role of banks as delegated monitors (e.g. Diamond, 1984), and as institutions responsible for extracting information from firms. This role of banks as

intermediaries helps alleviate some of the agency and informational failures in the capital markets. However, such intermediation is not without costs, and introduces its own set of moral hazard and other agency problems requiring some sort of external monitoring or supervision (see Dewatripont and Tirole, 1999, for an excellent survey). Our analysis sets out from the viewpoint that small depositors and investors need to be protected and represented by a banking regulator. We consider a regulator-bank/MFI two-layer hierarchy as a stylized model of a regulated microfinance sector, where the regulator may require the help of a supervising agency to collect information. Finally this paper is also related to the model heavily builds on Kofman and Lawarrée (1993), Laffont and Tirole (1993), and Giammarino, Lewis and Sappington (1993).
This paper deals with both the imperfection monitoring problem and incentive effects by explicitly modelling profit-maximizing behaviour by MFI who have better information about their environment and their activities than do regulators. Our study extends Giammarino, Lewis and Sappinton's focus on incentive compatibility requirements by analyzing the regulator's concern for social welfare. In Giammarino, Lewis and Sappington (1993) the bank retains its own profits, and the regulator is modelled as presenting a menu of options to the bank, these options linked to the required capital structure depending on the bank'type. Our designed incentive contracts are so to say the monetary equivalents of these options. Here, the regulator faces a trade-off between stronger incentives and the increased probability of bank failure (see Cordella and Yeyati, 1998, for a first exploratory analysis on public disclosure and banks' risk exposure). However, it seems that there is a widely held consensus among supervisory authorities on the importance of publicly disclosing bank information.
In contrast to Giammarino, Lewis and Sappington (1993), we assume no initial equity. This difference allows our model to capture the specific feature of the microfinance institutions in developing countries where MFI often lack resources. Another particularity and most important, in the model is that we introduce the government investment. We have proved that supervisor may help the regulator in reducing the informational asymmetry, and consequently leading to smaller distortions of effort and lower informational rents. Our analysis here of the optimal contracts specifies monetary transfers from the regulator to the MFI
This paper is organized as follows. In Section 2, we specify the model and characterize the optimal contract with full information. In Section 3, we derive the optimal contract with supervision and without supervision. Section 4 presents a numerical example to illustrate the results. Section 5 concludes.

2. THE MODEL AND BENCHMARK SOLUTIONS

2.1. *Central Elements of the Model.*

In our model, we consider both adverse selection and moral hazard. The MFI attracts deposits at a fixed interest and invests these in projects promising a random return, depending on the overall quality of the MFI's loan portfolio. The MFI is able to enhance this overall quality of its loan portfolio by exerting costly effort. The regulator does not know the MFI's exact type in terms of the exogenously given intrinsic quality nor observes its effort.

2.1.1. The MFI

At the beginning of the period $t=0$ initial deposits $D_0 \geq 0$ and donors and/or government investment I are used to finance loans L_0, that is $L_0 = D_0 + I$. It is throughout assumed that the MFI owns no equity. The MFI offers a standard debt contract that pays r per unit of deposit at maturity at $t=1$. Deposits are not insured and pay zero before maturity. We denote by $C(L_0)$, an increasing, strictly convex function, the cost of processing L_0 of risky loans. Hence the net return on risky loans is $RL_0 - C(L_0)$, where is the average rate of return of all projects financed by the MFI.

We assume that each borrower has access to an investment project. The borrower is unable to finance the project alone and thus requires an outside source of funding. For simplicity, we assume that MFIs are the only source of funds. Although each investment project requires the same amount of funding from the MFI, projects differ in their expected returns. The average rate of return R on all projects financed by the MFI is random, but its distribution depends on the overall quality q of the loan portfolio. More precise, higher levels of q shift the distribution of returns in the sense of first-order stochastic dominance (FOSD), that is, reduce the likelihood of low returns. Formally, R is the realization of a random variable that is distributed with cumulative density function $F(R/q)$ and a continuous and differentiable density $f(R/q)$ over the support $[\underline{R}, \overline{R}]$.

The overall quality of the MFI's loan portfolio consists of an exogenous and endogenous part. For simplicity, we assume that $q = q_0 + e$, where q_0 denotes exogenous quality and e denotes effort exerted by the MFI's management. Exogenous quality q_0 can take only two values, q_0^l and q_0^h, with $\Delta q_0 = q_0^h - q_0^l > 0$, where q_0^l obtains with probability ν and q_0^h with probability $1-\nu$. Hence, this defines two types of MFI: the high quality MFI and the low quality MFI. Following Giammarino, Lewis and Sappington (1993), the exogenous (intrinsic) quality captures all factors that beyond the bank's control, such as prevailing economic conditions or relevant characteristics of its customers. The bank/MFI is able to raise its overall quality q by exerting managerial effort e which decreases the marginal cost for a disutility $\psi(e)$ ($\psi' > 0, \psi'' > 0, \psi''' \geq 0$).

The crucial information asymmetry in this model concerns that neither the exact type of the bank/MFI q_0 nor the exerted effort e is observable to the regulator, but only known to the bank/MFI. However, overall quality q and realized gross profits are publicly observable and verifiable[1].

We assume that the regulator is benevolent and wishes to maximize social welfare. For so doing he can use transfers to the firm, say t. These transfers are raised with distortive taxes which create a social cost $\lambda > 0$.

The expected gross profit on its loan portfolio of a quality-i MFI as a function of effort is given by:

$$\pi_i(e) = \int_{\underline{R}}^{\overline{R}} [RL_0 - C(L_0) - r(L_0)] f(R/q) dR, \qquad (1)$$

Note that negative gross profits induce default since it is assumed that the MFI has no own equity. The probability of MFI failure as a function of effort is given by:

$$p_i(e) = \int_{\underline{R}}^{R} f(R/q(q_0^i)) dR, \qquad (2)$$

[1] This assumption is quite consistent with bank regulation practice of periodic inspections of bank assets and operations (see also Giammarino, Lewis and Sappington, 1993).

It follows that a high quality MFI needs to exert less effort than a low quality MFI to avoid MFI failure. That is given, $p_l(e) \geq p_h(e)$ for all $e \geq 0$.

Finally, realized profits at period t = 1 directly accrue to the regulator. In return the MFI is compensated for its effort by mean of a monetary transfer t. The MFI's expected utility U_{MFI} amounts to

$$U_{MFI} = t_i - \psi(e_i) - E[P]$$

where P denotes the possible punishment imposed on the MFI's management by the regulator, whenever suspected of shirking. However, the penalty imposed cannot exceed the net transfer, reflecting the limited liability of the MFI's management. That is, we impose $P \leq t$.

2.1.2. The supervisor

In our regulatory game the supervising agency has the ability to detect false reports of the MFI's management. In this sense it may prevent the MFI from shirking since the MFI faces a penalty if caught lying. Consequently, the costs of regulation may drop and better incentives for low quality MFI may result. Obviously much depend on the supervisor's accuracy to detect shirking behaviour. Moreover, it is assumed that the regulator is unable to perform the supervisory task itself. This could well be the case because supervision comprises of complex monitoring and auditing activities which require specific skills. Like the regulator the supervisor is uninformed about the MFI's true type q, but receives a signal σ which is imperfectly correlated with the MFI's exerted effort. This imperfect correlation reflects that a supervising agency probably has no access to all relevant material concerning the MFI's performance; it is only able to examine a sample of the MFI's files and records on which it bases its report to the regulator. It is assumed that the bank also observes the signal σ: the MFI knows which records and files were examined. The supervisor is assumed to always report truthfully.

The supervisor reports a signal σ, $\sigma \in \{q, \varnothing\}$ the regulator. The supervisor observes $\sigma = q_0$ with probability ξ and nothing with probability $1-\xi$.

So, $\Pr(\sigma = q_0) = \xi$, and $\Pr(\sigma = \varnothing) = 1-\xi$. The presence of the supervisor tilts the regulatory contract towards higher-powered incentives. This probability ξ reflects the signal's precision or accuracy. The supervisor may improve its accuracy, but only by incurring costs. It is assumed that these costs are increasing and convex in ξ, we model

$$C_s(\xi) = \frac{\xi^2}{2}. \qquad (3)$$

These costs may arise from direct and indirect sources. Directly, improving monitoring and auditing may require more human resources devoted to these tasks. Indirectly, when more accurate disclosed information triggers public concern if it reveals 'bad news' in the sense that it indicates a shirking MFI's management.

2.1.3. The Regulator's Problem

The role of the regulator is to maximize social welfare. It captures all profits from the MFI and designs the contract which it offers to the MFI's management to compensate for the exerted effort. The contract specifies a monetary transfer t from the regulator to the MFI, to which the regulator is irrevocably committed to pay just after the returns on the loans materialize at t = 1. More important is the informational restriction that although the regulator can in facts verify the overall quality q of the loan portfolio, it cannot discern between its individual components, effort e and type q_i. The cost function $\psi(e)$ and the functional relation between overall quality and effort, i.e. $q = q_0 + e$, are common knowledge. The informational asymmetry implies that no written contract can be contingent on effort directly, but instead must be geared to observable realized overall quality.

Social welfare in our model reflects expected MFI profits minus the costs generated by financial distress and costs of supervising. The costs of financial distress are given by the expected negative pay-offs during bankruptcy plus the social costs of financial distress which are assumed to be proportional to these losses. (A similar formulation is given by Giammarino, Lewis and Sappington,1993). That is, for i = l, h,

$$c_i(e) = (1+b)\int_{\underline{R}}^{\overline{R}} [RL_0 - C(L_0(q_0)) - rL_0(q_0)] f(R / q(q_0)) dR\,, \qquad b > 0 \tag{4}$$

Let q be the level of overall quality which brings to consumers a utility $S(q)$, $S' > 0, S'' < 0$. The cost of government involvement in the regulation and supervision of MFI's is captured by the assumption that the social cost of public funds used to finance the insurance program is $(1+\lambda) > 1$.

The regulator maximizes expected social welfare W, where:

$$W = E[(1+\lambda)(S(q) - (c + t + C_s - P)) + \pi] \tag{5}$$

We assume that the benevolent regulator is utilitarian. The writing of (5) emphasizes the fact that giving up a rent π to the bank/MFI is socially costly because it requires funding with taxes which create a deadweight loss.

Timing of events

The timing of the regulatory game is now as follows:

At t = 0:

- The MFI finance the investment project $L_0 = D_0 + I$.
- Nature chooses the MFI's type q. The MFI learns its type.
- The regulator offers a contract specifying a transfer $t(q,\sigma)$ to the MFI as a function of the observed overall quality and the reported signal; the probability ξ of the signal $\sigma = q$, the reimbursement of costs $C_S(\xi)$ to the supervisor, and the punishment P for the management.
- The regulator, the supervisor and the MFI sign the contract. The MFI chooses effort e which determines overall quality q.
- If sent by the regulator, the supervisor retrieves the signal σ.

At t = 1:

- Return on the loan portfolio materializes and transfers t are realized; the MFI pays r to depositors if $RL_0 - C(L_0) > rL_0$, otherwise it goes bankrupt and the regulator ceases its residual income.

2.2. The benchmark solution

We first introduce a benchmark model, where there are no informational asymmetries. It serves two purposes. On the one hand, it constitutes the foundation of the more general model. One the other hand, it allows to assess the role of supervisor. In this case the regulator is able to observe and verify the exact MFI's type and its effort, so he. maximizes

$$\max_{e_l, e_h, t_l, t_h} v[(1+\lambda)(S(q)-(c_l(e_l)+t_l))+\pi_l(e_l)]+(1-v)[(1+\lambda)(S(q)-(c_h(e_h)+t_h))+\pi_h(e_h)] \quad (6)$$

subject to

$$t_l \geq \psi(e_l)$$

and

$$t_h \geq \psi(e_h) \quad (7)$$

The inequalities (7) describe the individual rationality constraints for both types of banks/MFI. These constraints state that the bank need at least be compensated for the cost of its exerted effort. The benchmark solution is the policy that the regulator would implement if he shared the MFI's private information about the intrinsic quality level. Maximizing social welfare under participation constraint leads to the following proposition.

Proposition 1. The optimal contract under symmetric information is characterized by:

$$\psi'(e_i^*) = S'(e_i^*) - c_i'(e_i^*) \qquad i = l, h \quad (8)$$

The corresponding transfers are given by:

$$t_i^* = \psi(e_i^*), \qquad i = l, h \quad (9)$$

Proposition 1 state that at the first-best level of effort marginal gains of effort and marginal costs of effort are equated. Higher effort induces higher expected profits and lowers the probability of MFI failure, but increases the disutility of effort and therefore the required transfer for the MFI.

The regulator pays the MFI just enough to make it accept the contract. That is, the individual rationality constraints are binding for types of MFIs. In essence, without adverse selection, the moral hazard problem is solved by making the MFI for its own actions. Then, obviously, the bank chooses the right effort. The probability of MFI failure is zero $p_i \;\; i = l, h$ whatever the type of the MFI.

3. THE OPTIMAL INCENTIVE CONTRAT WITH INFORMATIONAL ASYMMETRY

In this case, it is assumed that the regulator faces adverse selection and moral hazard. In designing the contract, the regulator cannot condition on effort directly, so transfers have to be made a function of total realized quality q of the MFI's loan portfolio. Here, the regulator faces adverse selection and moral hazard. In general, adverse selection allows the high type to enjoy a positive informational rent from its interaction with the regulator, since it can always claim to be of low type, thereby economizing on costly effort. Hence, regulation becomes costly.

3.1. The Optimal incentive contract without supervision

Now, the regulator maximizes

$$\max_{e_l, e_h, t_l, t_h} v[(1+\lambda)(S(q)-(C_l(e_l)+t_l))+\pi_l(e_l)]+(1-v)[(1+\lambda)(S(q)-(C_h(e_h)+t_h))+\pi_h(e_h)] \quad (10)$$

subject to

$$t_l \geq \psi(e_l)$$

and

$$t_h \geq \psi(e_h) \quad (11)$$

$$t_l - \psi(e_l) \geq t_h - \psi(e_h + \Delta q_0) \text{ and } t_h - \psi(e_h) \geq t_l - \psi(e_l - \Delta q_0) \quad (12)$$

Inequalities (12) describe the incentive compatibility constraints. These constraints amount to saying that the contract designed for the high (low) quality MFI is the one preferred by the high (low) quality MFI. Incentive compatibility induce self selection. In essence, by choosing its preferred contract the bank reveals its type to the regulator. Using the Revelation Principle we may restrict ourselves to so-called direct revelation mechanisms which have to fulfil the incentive compatibility constraints.
Let $\phi(e) = \psi(e) - \psi(e - \Delta q_0)$. It is an increasing convex function from our previous assumptions. The incentive constraints can be rewritten:

$$\pi_l(e_l) \geq \pi_h(e_h) + \phi(e_h) \quad (13)$$

$$\pi_h(e_h) \geq \pi_l(e_l) - \phi(e_l + \Delta q_0) \quad (14)$$

Optimal regulation is then obtained by maximizing expected social welfare under the incentive and participation constraints. It is well known (see Laffont and Tirole, 1986) or Laffont and Martimort, 2002) that, in such a program, the participation constraint of the low-effort bank/MFI ($\pi_l(e_l) \geq 0$) and the incentive constraint of the high-effort bank/MFI (14) are the binding ones. The next proposition reports how the information asymmetry and the social cost of government financing combine to induce departures from the first-best solution.

Proposition 2. The optimal contract under asymmetric information without supervision is characterized by:

$$\psi'(e_l^{**}) = \frac{v(1+\lambda)(S'(e_l^{**}) - c_l'(e_l^{**})) - (1-v)(1+\lambda)\phi'(e_l^{**})}{v\lambda} \quad (15)$$

and

$$\psi'(e_h^{**}) = \frac{S'(e_h^{**}) - (1+\lambda)c_h'(e_h^{**})}{\lambda} \quad (16)$$

The corresponding transfers are given by:

$$t_l^{**} = \psi(e_l^{**}) \quad (17)$$

and

$$t_h^{**} = \psi(e_h^{**}) + \phi(e_l^{**}) \quad (18)$$

Proposition 2 shows a familiar result in incentive theory (Laffont and Tirole, 1986, 1993).
Under asymmetric information the high type obtains a positive informational rent, while the low type's effort level obtains no rent. In this case the individual rationality constraint of the

low quality MFI and the incentive compatibility constraint of the high quality MFI are binding. From (16), we see that for the high quality MFI we obtain the same effort level as under complete information (see equation (8)), from (18) the rent of high type is given by $\phi(e_l^{**})$. On the contrary from (15) and (17), we see that the effort level of low quality MFI is distorted downwards, and obtains no rent.

The intuition for the distortion in (15) is then clear. The ability of the high quality MFI to mimic the low type (due to the existence of asymmetric information) forcing the regulator to leave a rent if it wishes to have an active low quality bank/MFI. However, such a rent is socially costly because of the social cost of public funds.

3.2. The Optimal incentive contract with supervision

Let us continue to assume that the government is benevolent but that it uses a supervising agency to attempt to bridge its information gap. More specifically, employing a supervising agency enables the government to reduce the costs of regulation which are caused by leaving the high quality MFI an informational rent. Reducing this informational rent consequently leads to a smaller distortion in the effort level of the low quality MFI, which in turn reduces the probability of MFI failure. The regulator obtains a truthful report from the supervisor who is able to retrieve a signal about the MFI's exerted effort. The presence of the supervisor tilts the regulatory contract towards higher-powered incentives. Intuitively, when $\sigma = \varnothing$, the regulator believes that the MFI is efficient with a lower probability, he fears less giving up an information rent, affords a higher level of effort which increases the rent. Assume that the supervisor observes a signal σ in $\{q_0, \varnothing\}$. This signal σ is not perfect, but its accuracy can be improved at certain costs, $C_s(\xi)$, ξ being the probability of finding out the MFI's true type. If the supervisor indicates that the MFI's management has shirked, the regulator can impose a punishment to correct this undesired behaviour. Because of the possibility that new valuable information is retrieved with probability ξ, the incentive compatibility constraint must be modified.

$$t_h - \psi(e_h) \geq \xi(t_l - \psi(e_l - \Delta q_0) - P) + (1-\xi)(t_l - \psi(e_l - \Delta q_0)) \qquad (19)$$

Obviously, since the supervisor cannot collude with the credit cooperative, the optimal punishment is the maximal one, that is, $P = t$. Moreover there is no use in supervising when observing a high overall quality. In equilibrium, high overall quality reflects high effort under incentive compatibility[2]. Given ξ, the maximizing problem becomes:

$$\max_{e_l, e_h, t_l, t_h} v[(1+\lambda)(S(q) - (c_l(e_l) + t_l + C_s(\xi)) + \pi_l(e_l)]$$
$$+(1-v)[(1+\lambda)(S(q) - (c_h(e_h) + t_h)) + \pi_h(e_h)] \qquad (20)$$

subject to

$$t_l \geq \psi(e_l) \qquad 21)$$

.[2] This article abstracts from the possibility of sending the supervisor on a random basis when observing low overall quality; see Kofman and Lawarrée (1993) on this topic.

$$t_h - \psi(e_h) \geq (1-\xi)(t_l - \psi(e_l - \Delta q_0)) - \xi\psi(e_l - \Delta q_0) \tag{22}$$

A solution of this problem is giving in the following proposition.

Proposition 3. The optimal incentive contract with supervision is characterized by:

$$\psi'(e_l^{***}(\xi)) = \frac{v(1+\lambda)(S'(q) - c_l'(e_l^{***}) + (1-v)\phi'(e_l^{***})}{v\lambda + (1-v)\xi} \tag{23}$$

and

$$\psi'(e_h^{***}) = \frac{(1+\lambda)(S'(e_h^{***}) - c_h'(e_h^{***}))}{\lambda} \tag{24}$$

The corresponding transfers are given by:

$$t_l^{***}(\xi) = \psi(e_l^{***}(\xi)) \tag{25}$$

$$t_h^{***}(\xi) = \psi(e_h) + \phi(e_l^{***}(\xi)) - \xi(\psi(e_l^{***}(\xi)) \tag{26}$$

From Proposition 3 it immediately follows that the effort level is increasing in the probability ξ. Hence, as the accuracy of supervision improves, the distortion of the effort becomes smaller.

4. A NUMERICAL EXAMPLE

The distribution of the average rate of return R on all projects financed by the MFI depends on the overall quality q of the loan portfolio. More precise, higher levels of q shift the distribution of returns in the sense of first-order stochastic dominance, that is, reduce the likelihood of low returns. Here, we model that the mean return on the loan portfolio is increasing in the overall quality, but its standard deviation remains constant. Formally, we assume that R is uniformly distributed on the interval $[q - \frac{\mu}{2}, q + \frac{\mu}{2}]$, implying probability distribution $F(R/q) = \frac{R-q}{\mu} + \frac{1}{2}$ and density $f(R/q) = \frac{1}{\mu}$.

Note that the density is independent from q and observe that conditional expectation and standard deviation are given, respectively, by $E(R/q) = q$ and $\sigma(R/q) = \frac{\mu}{\sqrt{12}}$.

The expected gross profits on of a quality-i MFI as a function of effort is given by:

$$\pi_i(e) = \frac{1}{\mu} \int_{\max\left\{r, (q_0^i + e) - \frac{\mu}{2}\right\}}^{(q_0^i + e) + \frac{\mu}{2}} [RL_0 - C(L_0) - rL_0] dR \tag{27}$$

which leads to:

$$\pi_i(e) = \frac{1}{2\mu}\left[\left(q_0^i + e + \frac{\mu}{2}\right) - r\right]^2 L_0 \text{ for } e < (r - q_0^i) + \frac{\mu}{2}. \tag{28}$$

and

$$\pi_i(e) = \left[\left(q_0^i + e\right)L_0 - C(L_0) - rL_0\right], \quad \text{for } e \geq (r - q_0^i) + \frac{\mu}{2}. \tag{29}$$

To ensure non-negative returns on the loan portfolio for all effort levels in both states, we restrict $\mu \in [0, 2q]$. The probability of MFI failure as a function of effort is given by:

$$p_i(e) = \frac{1}{\mu} \int_{\min\left\{r, q_0^i + e - \frac{\mu}{2}\right\}}^{r} dR = \max\left\{0, \frac{r - (q_0^i + e)}{\mu} + \frac{1}{2}\right\} \qquad i = L, H \tag{30}$$

The costs of financial distress $c_i(e)$ is defined by :

$$c_i(e) = \frac{(1+b)}{\mu} \int_{\min\left\{r, q_0^i + e - \frac{\mu}{2}\right\}}^{r} \left(RL_0 - C(L_0) - rL_0\right) dR, \tag{31}$$

We assume that the MFI management's disutility is given by $\psi(e) = \frac{e^2}{2}$, $e \geq 0$.

Let be the parameter values $v = 0.5$; $q_0^l = 1$; $q_0^h = 1.5$; $r = 1.1$; $b = 2$; $L_0 = 1$ and $\lambda = 0,20$.
We normalize the net return on risky loans to unity, that is $R - C = 1$.

The optimal contract under symmetric information (benchmark) is characterized by:
Benchmark case.

$e_l = 1$	$e_h = 1$
$t_l = 0,5$	$t_h = 0,5$
$p_l = 0$	$p_h = 0$

$W = 0,613$

No MFI receives any rent; whatever its type, the regulator pays the MFI just enough to make it sign the contract (i;e. $t_i = \psi(e_i)$, $i = l, h$). The probability of MFI failure is zero.

Contract without supervision

$e_l = 0,625$	$e_h = 1$
$t_l = 0,195$	$t_h = 0,687$
$p_l = 0,06$	$p_h = 0$

$W = 0,519$

MFI high type has a positive rent $\phi(0,625) = t_h - \psi(1) = 0,187$. MFI low type $(e_l < 1)$ obtains no rent, i.e. $t_l = \psi(e_l)$.. The probability of MFI failure is still zero for the high type, but rises for the low type. Obviously, the regulator's expected utility is lower than in benchmark case. Thus, in conclusion, when facing adverse selection the costs of regulation increases and that the optimal response for the regulator is to shift from a high-powered contract to contract with lower power. As a consequence, informational asymmetries increase the instability of the MFI sector since $p_l > 0$.

Contract with supervision

$\xi = 0,23$

$e_l = 0,685$ $\quad$ $e_h = 1$

$t_l = 0,235$ $\quad$ $t_h = 0,663$

$p_l = 0,012$ $\quad$ $p_h = 0$

$$W = 0,530$$

By comparing the results to the case without supervision, the low type is provided with better incentives (0,685>0,625), while the rent for the high type is lower (0,663<0,687). Hence, by using a supervising agency the regulator can afford a higher powered contract. The probability of MFI failure for the low quality bank drops to 0,012. This result shows that even in the optimal monitoring scheme there still exists a positive probability of MFI. Full information disclosure need not be optimal for the regulator.

5 CONCLUSIONS

In this paper, we introduced a framework for designing and analyzing the properties of the optimal regulation of a single microfinance institution that has private information on the intrinsic quality of its loan portfolio (adverse selection) and where the MFI's choice of effort to improve this quality cannot be observed by the regulator (moral hazard).

In designing the contract the regulator faces a trade off between inducing proper incentives and the costs of regulation as a consequence of informational asymmetries. This may create a demand for information gathering. If observed overall quality is low the regulator may decide to use a supervising agency. The supervisor collects information and retrieves a signal about the MFI's intrinsic quality, however not with perfect certainty. By incurring costs, the supervisor is able to punish the MFI's management if caught lying. In designing optimal contracts the regulator trades off incentives for efficient MFI against costs of regulation.

The paper provides useful information for guiding microfinance reforms in developing countries. By extending Giammarino, Lewis, and Sappington's (1993) model to the microfinance market with supervision and government investment we have proved that supervisor may help the regulator in reducing the informational asymmetry, and consequently leading to smaller distortions of effort and lower informational rents. Our analysis here of the optimal contracts specifies monetary transfers from the regulator to the MFI. These monetary transfers are not commonly observed in practice. The paper shows that weak legal and regulatory frameworks do not need to be a binding constraint for effective supervision. Policies promoting private incentives and market-discipline can overcome some of these deficits. In the first-best solution, the regulator is able to observe and verify the exact MFI's type and its exerted effort. Supervision costs are normalized at zero. Supervision and disclosure play no role in this setting. We then turn to the optimal incentive contract with informational asymmetry but no supervision agency available. Finally, the optimal incentive contract is characterized where supervision does play an active role. We study the balance between proper incentives, costs of regulation, probability of bank failure, and costs of active supervision. The content of information disclosure is characterized by the optimal monitoring scheme.

Our study abstracts form several factors that could be included in future research. First, although the interaction between regulator and MFI is not repeated, qualitative conclusions will continue to hold in many settings with repeated play. Second, we characterize information disclosure by the optimal monitoring scheme. However, the decision whether or not to bring out the information found by the supervisor to the public is not really modelled. The optimal regulation policies in these situations merit further investigation.

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