



INCENTIVES, SUPERVISION, AND REGULATION OF MICROFINANCE INSTITUTIONS IN DEVELOPING COUNTRIES

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Abstract: We analyse the optimal regulation of a Microfinance Institution (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 trade-off 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, a positive probability of MFI failure generally exists. The optimal monitoring scheme characterizes the content of information disclosure.

Keywords: Microfinance institution, adverse selection, moral hazard, regulation, supervision, optimal incentive contracts, developing countries.

1. INTRODUCTION

Microfinance, i.e. the provision of financial services to low-income households and micro and small enterprises (MSEs), provides an enormous potential to support the economic activities of the poor and thus contribute to poverty alleviation, ([9] Cull, Demirgüç-kunt, & Morduch, 2009a). Widespread

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experiences and research have shown the importance of savings and credit facilities for the poor and MSEs. This emphasizes 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 has been frequently raised in recent years and his news is particularly linked to that of the institutionalization of the IMF, which often highlighted the gaps or the absence of a regulatory framework. A paper published in the Microfinance series Consensus Guidelines of the [6] CGAP (Guiding Principles on Regulation and Supervision of Microfinance (2011) has 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. ([23] Morshed, Habib, & Jubb, 2020; [1] Bansah, & Adjei, 2023; [15] Gupta, & Sharma, 2023).

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, ([4] Chen, & Divanbeigi, 2019).

Generally, the main justifications for 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, ([25] Rochet, 1992). 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, ([26] Van Gruening, Gallardo & Randhawa, 1999).

Interest in the regulation and supervision of MFIs has arisen from their growth and 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, ([8] Cuevas & Fischer, 2006; [2] Berenbach, & Churchill, 1997). Through regulation, MFIs can also be integrated into the formal financial sector, ([4] Chen, & Divanbeigi, 2019). 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 [5] Christen, Lyman & 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 ([3] Chavez, & 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, ([27] Vogel, Gomez & Fitzgerald, 2000). It is implemented through examination practices and monitoring mechanisms that determine the real risks faced by the financial intermediary. [21] Llewellyn, (1986) defines supervision as the process of monitoring that institutions are conducting their business either under regulations or more generally in a prudent manner. Therefore, regulation typically refers to the rules that govern the behaviour of 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 that are considered 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, 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 ([5] Christen, Lyman & 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 safety and soundness of financial institutions ([22] Llewellyn, 1999).

When regulation is discussed about 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 banks' 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 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 [10] Cull, Demirgüç-kunt, & Morduch, 2009b; [24] Ndambu, 2011). They have analysed the impact of regulation on financial intermediaries (including MFIs) worldwide, deriving potential implications of microfinance supervision consistently and moving one step beyond countries' anecdotal evidence. [16] Hartarstka, (2005) finds that regulated microfinance institutions in Central and Eastern Europe and the Newly Independent States have lower returns 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, [17] Hartarska & Nadolnyak (2007) have conducted 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 fewer 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. [12] Elzahi Saaid (2022) examines the effect of regulation on microfinance institutions (MFIs) sustainability and outreach in Sub Saharan Africa (SSA). Using unbalanced panel data from 2002 to 2012 for 30 countries and a multilevel estimation technique, he finds that regulation helps improve the sustainability and breadth of outreach

but not the depth. He, also, finds that MFIs that accept deposits have better sustainability but tend to serve the marginal poor, and regulatory quality has a positive impact on outreach and sustainability. [28] Zainal et al. (2020) studied the impact of regulation, supervision, and social and financial efficiency of microfinance institutions in ASEAN-5 countries. They showed that bank regulation negatively influenced the level of social efficiency and bank supervision impacted the level of financial efficiency of the sampled MFIs positively. This result provides new insights for bank regulators and policymakers to construct regulatory frameworks that are relevant to the operation of MFIs.

In this paper, we analyse 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 considering all costs and benefits of such a scheme.

The theoretical literature on banking (see [13] Freixas & Rochet, 1998), for an excellent survey) has focused on the role of banks as delegated monitors 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 [11] Dewatripont & Tirole, 1994), 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 built on [18] Kofman & Lawarrée (1993); [20] Laffont & Tirole (1993), and [14] Giammarino, Lewis & 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. MFI regulation refers to extent of profit sharing between the regulator and the MFI. In particular, it is assumed that the regulator captures all profits of the MFI and compensates the MFI's management for its exerted effort by offering a contract that specifies a monetary transfer from the regulator to the MFI.

In [14] Giammarino, Lewis & Sappington (1993) the bank retains its profits, and the regulator is modelled as presenting a menu of options to the bank, these options are linked to the required capital structure depending on the bank's 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 [7] Cordella & 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 [14] Giammarino, Lewis & Sappington (1993), we assume no initial equity. This difference allows our model to capture the specific features of microfinance institutions in developing countries where MFI often lack resources. Another particularity and most important, in the model is that we introduce the donors or government investment. We have proved that supervisors may help the regulator in reducing the informational asymmetry, 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 can enhance the 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 assumed that the MFI owns no equity. Without loss of generality, the MFI offers a standard debt contract that pays r per unit of deposit and investment 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. Let R be the average rate of return on all projects financed by the MFI. Hence the net return on risky loans is $RL_0 - C(L_0)$.

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 precisely, 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 $[(\underline{R}/q), (\bar{R}/q)]$.

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 [14] Giammarino, Lewis & Sappington (1993), the exogenous (intrinsic) quality captures all factors that are 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.

We assume that the regulator is benevolent and wishes to maximize social welfare. or 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:

$$\pi_i(e) = \int_{\max\{r, \underline{R}/q(q_0^i, e)\}}^{\bar{R}/q(q_0^i, e)} [RL_0 - C(L_0) - rL_0]f(R/q)dR, \quad (1)$$

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:

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

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

$$U_{MFI} = t_i - \psi(e_i) - E[P] \quad (3)$$

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

Informational asymmetries induce a loss of control for the MFI regulator and limit the effectiveness of its regulatory policy. This loss of control may be mitigated by collecting MFI specific information, creating the need for

active prudential supervision. A supervising agency, acting on behalf of the MFI regulator, may be able to resolve the informational asymmetries between the regulator and the MFI, depending on its competence and ability to gather information. We assume that the supervisor retrieves a signal imperfectly correlated with the MFI's intrinsic quality and that it is able to improve this signal at certain costs. These costs reflect on the one hand the direct costs of devoting more resources to the supervisory task, but on the other hand, also the costs attached to increased public concern about the soundness of the inspected MFI when the disclosed information turns out to be bad. In the event that the MFI's management is caught shirking, the regulator may react by imposing a punishment to correct this undesired behaviour.

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 depends 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 , $\sigma \in \{q, \emptyset\}$ the regulator. The supervisor observes $\sigma = q_0$ with probability ξ and nothing with probability $1 - \xi$.

So, $\Pr(\sigma = q_0) = \xi$, and $\Pr(\sigma = \emptyset) = 1 - \xi$. 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 by

$$C_s(\xi) = \frac{\xi^2}{2}. \quad (4)$$

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 accurately 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 that 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 verify the overall quality q of the loan portfolio, it cannot discern between its individual components, effort, 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 the sum of surplus in society: the consumer’s net welfare, the manager’s utility and 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 [14] Giammarino, Lewis & Sappington, 1993). That is, for $i = l, h$,

$$c_i(e) = (1 + b) \int_{\min\{r, R/q(q_0, e)\}}^r [RL_0 - C(L_0(q_0)) - rL_0(q_0)] f(R/q(q_0)) dR, \quad b > 0 \quad (5)$$

where the parameter b is the proportional of the cost of financial distress.

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

The regulator maximizes expected social welfare W , where:

$$W = E[S(q) - (1 + \lambda)(c + t + C_S - \pi - P) + U] \quad (6)$$

We assume that the benevolent regulator is utilitarian. The writing of (6) emphasizes the fact that giving up a rent π to the bank/MFI is socially costly because it requires funding with taxes which creates 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 and investors 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. On the other hand, it allows us to assess the role of the supervisor. In this case, the regulator is able to observe and verify the exact MFI's type and its exerted effort. Supervision and disclosure play no role in this setting. In the first-best case, the regulator maximizes

$$\begin{aligned} \max_{e_l, e_h, t_l, t_h} & v\{S(q(e_l)) - (1 + \lambda)(c_l(e_l) + t_l - \pi_l(e_l)) + U_l\} \\ & + (1 - v)\{S(q(e_h)) - (1 + \lambda)(c_h(e_h) + t_h - \pi_h(e_h)) + U_h\} \end{aligned} \quad (7)$$

subject to

$$t_l \geq \psi(e_l) \text{ and } t_h \geq \psi(e_h) \quad (8)$$

The inequalities (8) describe the individual rationality constraints for both types of MFI ($U_l(e_l) \geq 0$ and $U_h(e_h) \geq 0$). These constraints state that the MFI needs at least be compensated for the cost of its exerted effort. Without loss, its reservation utility is normalized at zero. 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:*

$$\psi'(e_i^*) = \frac{1}{1 + \lambda} S'(q(e_i^*)) + \pi'_i(e_i^*) - c'_i(e_i^*) \quad i = l, h \quad (9)$$

The corresponding transfers are given by:

$$t_i^* = \psi(e_i^*), \quad i = l, h \quad (10)$$

Proposition 1 states that at the first-best level of effort marginal gains 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 manager of MFI just enough to make it accept the contract. That is, the individual rationality constraints are binding for both types of MFIs. In essence, without adverse selection, the moral hazard problem is solved by making the MFI residual claimant for its own actions. Then, the MFI chooses the right effort. The probability of MFI failure is zero $p_i = 0 \ i = l, h$ whatever the type of the MFI.

3. THE OPTIMAL INCENTIVE CONTRACT WITH INFORMATIONAL ASYMMETRY

In this case, it is assumed that the regulator faces adverse selection and moral hazard, the regulator cannot discern between the MFI's exact type and its effort level. 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. 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, the regulator must weigh the gains from inducing optimal effort against the costs of leaving a rent.

3.1. The Optimal Incentive Contract without Supervision

Now, the regulator maximizes

$$\begin{aligned} \max_{e_l, e_h, t_l, t_h} & v\{S(q(e_l)) - (1 + \lambda)(c_l(e_l) + t_l - \pi_l(e_l)) + U_l\} \\ & + (1 - v)\{S(q(e_h)) - (1 + \lambda)(c_h(e_h) + t_h - \pi_h(e_h)) + U_h\} \end{aligned} \quad (11)$$

subject to

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

$$t_l - \psi(e_l) \geq t_h - \psi(e_h - \Delta q_0) \text{ and } t_h - \psi(e_h) \geq t_l - \psi(e_l + \Delta q_0) \quad (13)$$

Inequalities (13) 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 induces 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:

$$U_l(e_l) \geq U_h(e_h) + \phi(e_h)$$

and

$$U_h(e_h) \geq U_l(e_l) - \phi(e_l + \Delta q_0) \quad (14)$$

Optimal regulation is then obtained by maximizing expected social welfare under the incentive and participation constraints. It is well known (see [19] Laffont & Tirole, 1986) that, in such a program, the participation constraint of the low-effort bank/MFI ($U_l(e_l) \geq 0$) 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:*

$$\psi'(e_l^{**}) = \frac{1}{1+\lambda} S'(q(e_l^{**})) + \pi'_l(e_l^{**}) - c'_l(e_l^{**}) + \frac{\lambda}{1+\lambda} \frac{(1-\nu)}{\nu} \phi'(e_l^* + \Delta q_0) \quad (15)$$

and

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

The corresponding transfers are given by:

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

and

$$t_h^{**} = \psi(e_h^{**}) - \phi(e_l^{**} + \Delta q_0) \quad (18)$$

Following this proposition under asymmetric information the high type exerts the first-best level of effort and obtains a positive informational rent, while the low type's effort level is distorted away from the first-best level and obtains no rent (see also, [19-20] Laffont & Tirole, 1986, 1993). 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 (17), we see that for the high-quality MFI, we obtain the same effort level as under complete information (see equation (9)), and from (18) the rent of high type is given by $\phi(e_l^{**})$ and is increasing in the low type's effort level ($\phi(e)$ is an increasing convex function). 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) forces 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 $\sigma = \emptyset$, 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 $\{q_0, \emptyset\}$. 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.

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

Since the supervisor cannot collude with the credit cooperative, the optimal punishment is the maximal one, that is, $P = t_l$. Moreover, there is no use in

supervising when observing a high overall quality. In equilibrium, high overall quality reflects high effort under incentive compatibility. Given ξ , the maximizing problem becomes:

$$\begin{aligned} \max_{e_l, e_h, t_l, t_h} & v\{(S(q) - (1 + \lambda)[c_l(e_l) + t_l + C_s(\xi) - \pi_l(e_l)] + U_l)\} \\ & + (1 - v)\{(S(q) - (1 + \lambda)[c_h(e_h) + t_h] - \pi_h(e_h)) + U_h\} \end{aligned} \quad (20)$$

subject to

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

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

A solution to this problem is given in the following proposition.

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

$$\psi'(e_l^{***}(\xi)) = \left(\frac{v}{v + (1 - v)\xi} \right) \left\{ \frac{1}{1 + \lambda} (S'(e_l^{***})) + \pi'_l(e_l^{***}) - c'_l(e_l^{***}) \right\} - \left(\frac{1 - v}{v + (1 - v)\xi} \right) \phi'(e_l^{***}) \quad (23)$$

and

$$\psi'(e_h^{***}) = \frac{1}{1 + \lambda} (S'(e_h^{***})) + \pi'_h(e_h^{***}) - c'_h(e_h^{***}) \quad (24)$$

The corresponding transfers are given by:

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

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

From Proposition 3 it immediately follows that the effort level of the low type is increasing in the probability ξ , that is $\partial \psi'(e_l^{***}(\xi)) / \partial \xi > 0$. Hence, as the accuracy of supervision improves, the distortion of the effort becomes smaller. Obviously, for $\xi = 0$ (no value of supervision) we have $\psi'(e_l^{***}(0)) = \psi'(e_l^{**})$. Since effort increases with v , the probability of bank failure

of a low type decreases. However, improving the accuracy of the signal is not without costs. The regulator must weigh the costs and the benefits of supervising.

When facing adverse selection, the MFI regulator cannot offer the first-best contract, since it would leave the high-quality MFI a too high an informational rent. In designing optimal contracts, the regulator trades off incentives for efficient MFI against costs of regulation. In doing so, the effort level of a low-quality bank is distorted away from the first-best level, which increases the instability of the banking sector as a whole. It follows that the optimal regulatory response to asymmetric information is a shift from 'high-powered' toward 'low-powered' contracts, that is, toward contracts inducing less effort to improve the quality of the MFI's loan portfolio. In this respect, a supervising agency may help the regulator in reducing the informational asymmetry, consequently leading to smaller distortions of effort and lower informational rents. However, prudential supervision is costly. The analysis reveals that even in the optimal monitoring scheme, there generally exists a positive probability of bank failure. In this sense, full information disclosure in terms of requiring a very high level of accuracy in supervision need not be optimal for the regulator

In this article, information disclosure is characterized by the optimal monitoring scheme. However, the decision of whether or not to bring out the information found by the supervisor to the public is not really modelled. In fact, it is implicitly assumed that the information revealed to the regulator is transmitted to the public. The exogenously specified costs of supervision try to partly capture the (future) cost attached to public concern when reacting to bad information. Still, endogenizing this behaviour of depositors in the model as part of the decision-making process facing the regulator would certainly increase its validity.

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 precisely, 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 of a quality- i MFI as a function of effort are given by:

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

which leads to:

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

and

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

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:

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

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

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

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

Let be the parameter values $\nu = 0.5$; $q_0^l = 1$; $q_0^h = 1.5$; $r = 1.1$; $b = 2$; $L_0 = 1$ and $\lambda = 0,20$.

We normalize the net return on risky loans to unity, that is $R - C = 1$ and we suppose that the utility $S(q)$ is defined by a negative exponential utility function of the form $S(q) = -e^{-q}$.

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

Benchmark case.

$$\begin{aligned} e_l &= 1 & e_h &= 1 \\ t_l &= 0,5 & t_h &= 0,5 \\ p_l &= 0 & p_h &= 0 \\ W &= 0,346 \end{aligned}$$

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

$$\begin{aligned} e_l &= 0,625 & e_h &= 1 \\ t_l &= 0,195 & t_h &= 0,687 \\ p_l &= 0,06 & p_h &= 0 \\ W &= 0,252 \end{aligned}$$

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. The regulator's expected utility is lower than in the benchmark case. Thus, in conclusion, when facing adverse selection, the costs of regulation increase, and the optimal response for the regulator is to shift from a high-powered contract to a contract with lower power. As a consequence, informational asymmetries increase the instability of the MFI sector since $p_l > 0$.

Contract with supervision

$$\begin{aligned}\xi &= 0,23 \\ e_l &= 0,685 & e_h &= 1 \\ t_l &= 0,235 & t_h &= 0,663 \\ p_l &= 0,012 & p_h &= 0 \\ W &= 0,263\end{aligned}$$

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 analysing 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

can 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. Our analysis here of the optimal contracts specifies monetary transfers from the regulator to the MFI. These monetary transfers are considered as subsidy to the MFI so the incentive mechanism in this paper is another form of smart subsidy. 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 from several factors that could be included in future research. First, although the interaction between the 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 of 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 merits further investigation.

APPENDIX

Proof of Proposition 1

The regulator maximizes

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

subject to

$$t_l \geq \psi(e_l) \quad \text{and} \quad t_h \geq \psi(e_h)$$

Note that the regulator's objective function is decreasing in the transfer t_i , $i = l, h$. Therefore, $t_i = \psi(e_i)$, $i = l, h$. Substituting, and differentiating to e_i ,

$i = l, h$, gives the first order condition
 $S'(e_i^*) - (1 + \lambda)[c'_i(e_i^*) - \pi'_i(e_i^*) + \psi'(e_i^*)] = 0, i = l, h$ implying

$$\psi'(e_i^*) = \frac{1}{1 + \lambda}(S'(e_i^*)) + \pi'_i(e_i^*) - c'_i(e_i^*), \quad i = l, h, \text{ and therefore } t_i^* = \psi(e_i^*),$$

$i = l, h$. The above maximization program is convex so that the second-order conditions need not be checked.

Proof of Proposition 2

The regulator maximizes

$$\begin{aligned} \max_{e_l, e_h, t_l, t_h} & \{S(q) - (1 + \lambda)[c_l(e_l) + t_l(e_l) - \pi_l(e_l)] + U_l\} \\ & + (1 - \nu)\{S(q) - (1 + \lambda)[c_h(e_h) + t_h(e_h) - \pi_h(e_h)] + U_h\} \end{aligned}$$

subject to

$$t_l \geq \psi(e_l) \text{ and } t_h \geq \psi(e_h)$$

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

It is well known that in the optimum the two constraints bind. Substituting, and differentiating to $e_i, i = l, h$ gives two first-order conditions:

$$\nu\{S'(e_l) - (1 + \lambda)[c'_l(e_l) - \pi'_l(e_l) + \psi'(e_l)]\} - (1 - \nu)(1 + \lambda)[\psi'(e_l) - \psi'(e_l - \Delta q_0)] = 0$$

$$S'(e_h) - (1 + \lambda)[c'_h(e_h) - \pi'_h(e_h) + \psi'(e_h)] = 0$$

Implying

$$\psi'(e_l^{**}) = \frac{1}{1 + \lambda}(S'(e_l^{**})) + \pi'_l(e_l^{**}) - c'_l(e_l^{**}) - \frac{(1 - \nu)}{\nu}\phi'(e_l^{**})$$

where $\phi'(e_l^{**}) = \psi'(e_l^{**}) - \psi'(e_l^{**} - \Delta q_0)$

and

$$\psi'(e_h^{**}) = \frac{1}{1 + \lambda}(S'(e_h^{**})) + \pi'_h(e_h^{**}) - c'_h(e_h^{**})$$

Using the two binding constraints we obtain

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

$$t_h^{**} = \psi(e_h^{**}) + \psi(e_l^{**}) - \psi(e_l^{**} - \Delta q_0)$$

The maximization program is convex so that the second-order conditions need not be checked.

Proof of Proposition 3

The regulator maximizes

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

$$+ (1 - v)\{ (S(q) - (1 + \lambda)[c_h(e_h) + t_h - \pi_h(e_h)] + U_h) \}$$

subject to

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

$$t_h - \psi(e_h) \geq (1 - \xi)(t_l - \psi(e_l - \Delta q_0)) - \xi\psi(e_l - \Delta q_0)$$

The approach is the same as previously, in the optimum the two constraints bind. Substituting, and differentiating to $e_i, i = l, h$ gives two first-order conditions in two unknowns. Solving gives $\psi'(e_l^{***})$ and $\psi'(e_h^{***})$. Using the two binding constraints we obtain t_l^{***} and t_h^{***} .

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