Financing coops in asymmetric information

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Abstract
This work relies on the principal agent theory to consider information asymmetry between banks and cooperatives. In our setting, we explicit the utility related to the disposal of internal fund to manage the payment to cooperative members, as well as the discounting factor of cooperatives. The information asymmetry concerns the probability of success p (or reciprocally the likelihood of default). Our model includes investment tangibility and prospects of value creation. We show that the bank can deal with information asymmetry by reducing the interest rate of riskiest cooperatives to reduce the incentive to mimic the safest ones. These latter pay a higher than optimal interest rates but benefit from a lower required amount of internal funds to finance investment, providing them with a slack to manage the payment to cooperative members, which is an important lever to gain their commitment in cooperative projects. Our model provides a new insight on financial constraints of cooperatives. Bank and cooperative relationship appears as a key-element of the lifecyle of cooperatives.

Keywords
Cooperative, bank finance, investment, asymmetric information, principal agent.

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1 Introduction

Because of their core governance features, such as limitations in trading ownership shares, cooperatives are expected to face financial constraints (Staatz (1989), Chaddad et al. (2005), Russell et al. (2017)). Chaddad et al. (2005) provide evidence of financial constraints, by revealing that investments of cooperatives are particularly sensitive to internal funds. Russell et al. (2017) emphasize the role of debt as the main alternative to equity for cooperative finance, meaning that bank appears as the main external resource for cooperatives. But the cooperative and bank relation is affected by information asymmetry. Cross and Buccola (2004) show that, because of information asymmetry, cooperative members can increase their current cash income in the detriment of the cooperative solvency and thus, push the cooperative in a hidden liquidation process. Because of their lack of faith in the board's discipline with balance sheet management, lenders can encourage cooperatives to increase the amount of equity not subject to redemption so that it becomes "permanent" (Boland, 2012). This reveals that the trade-off between payment to producers and needs for internal funds via retained earnings is an issue for the bank. In our view, this can be interpreted as an outcome of implicit contracts between the bank and cooperatives aiming.

We propose a theoretical insight on this issue with a principal-agent model making explicit the short-run utility of cash, compared to the value created by investment, and the probability of success on which there can be information asymmetry. The model enables a discussion on the investment horizon by considering a different discounting factor for cooperatives and the bank. Indeed, a short investment horizon can be another direct consequence of the a-capitalism principle (Staatz (1989), Cook (1995) and Russell et al. (2017)). Moreover, asset tangibility (for collateralization) is also a key-variable, given that difficulties for cooperatives to invest in intangible assets may limit value creation. We here propose as a contractual device the possibility, for the bank, to ask for an internal fund contribution to investment. This approach is consistent with our model as the bank can observe all the variables necessary to assess this contribution. Moreover, it is also simple and realistic enough to apply in contexts where contract sophistication is not possible. In our view, this is in line with the bank-cooperative relation viewed in Boland (2012). Our model shows that the bank should apply a higher than first-best interest rate to the less risky cooperatives, implying underinvestment, and a lower than first-best interest rate to the risky cooperatives, implying overinvestment. However, the less risky cooperatives benefit from a much lower required contribution to investment by the bank. As such, they are able to provide a higher payment to cooperative members, which reduces the impact of financial constraints on investment, while risky cooperatives will have to devote a significant part of the current payment of members to investments, implying a strong disincentive to invest.

This result provides a new way for considering the link between financial constraints of cooperatives and payment to cooperative members: there is underinvestment from the best cooperatives because of a high interest rate, but the lower requirements of internal fund to invest provide more flexibility for the payment to cooperative members and so, expand capacity to invest in value increasing projects. In our view, this result confirms the critical role of the bank in the ability of cooperatives to expand their business with the support of cooperative members, by preserving their short-run needs.

After a description of the model as a benchmark case (section 2), we develop the incentive contract build by the bank which is composed of an interest rate and a financial contribution for each type of cooperative (section 3). Finally, we conclude (section 4).

2 The Model

2.1 The benchmark case: financing coops with internal funds

In the benchmark case, the cooperative has enough internal funds to finance investment. Considering G as the exogenous gain making the internal funds of the cooperative, i the level of investment, ρ_c the discounting factor of the cooperative, and $V(i)$ the long term value function created by investment i. Let's consider that G is large enough so as $G-i \geq 0$ in any case, and that the cooperative cannot use debt. The function $V(i)$ is increasing and concave in comparison to i. In this context, the optimal level of investment $\hat{i}$ is such that:

$$\begin{cases} \frac{dV(i)}{di} = V_i(\hat{i}) = \frac{1}{\rho_c} \\ G - \hat{i} \geq 0 \end{cases} \tag{1}$$

In optimum, the level of investment is such that the marginal value of investment is equal to the reverse of the discounting factor of cooperatives. In this context the level of investment depends on their investment horizon. This result is standard in the literature. In this setting we consider that $(G - \hat{i})$ is used for short term cash payment to cooperative members.

2.2 Financing coops with debt

In the following, the cooperative has not enough internal funds G to finance investments but it can use debt d provided by the bank. We here distinguish short term and long term utilities for cooperative members who decide the level of debt and investment which are the strategic variables. The cooperative profit function can be formalized as follows:

$$\Pi(d, i) = U(d, i, G) + \rho_c V(i) - \rho_c p(1 + r^*)d$$

Where the function $U(d, i, G)$ corresponds to the short term utility depending on the level of debt raised d, the level of investment i and the exogenous internal fund G. Let consider C, the available amount of cash in the short term which correspond to the sum of debt plus internal fund minus investment ($C = d + G - i$). The function U is quasi-concave in all the terms of C. As the bank denies to lend more than the invested amount: $d - i \leq 0$, so that $C \leq G$. Moreover, for ease of computation and without loss of generality, we assume that $U(0) = 0$ and $U(G) = G$. The function $V(i)$ corresponds to the long term value of investment. Finally, $\rho_c p(1 + r^*)d$ corresponds to the discounted total cost of debt with r^* the interest rate determined according to p the probability of success. The interest rate decreases as the probability of success increases. For sake of simplicity, in case of failure the cooperative is not able to repay the bank at all (except through collateral related to investment tangibility, see later).

Assumption 1 : $U_i(d,i) = -U_d(d,i)$

Assumption 1 says that the short term marginal utility of one dollar in debt is equal to the short term marginal disutility of one dollar invested[1]. In other words, the marginal utility of a dollar always has the same utility as it comes from debt wherever it is invested. This assumption looks quite natural, but arguing it enables to take into account the degree with which the cooperative's director behave more as a cooperative member or as a manager (we will develop this aspect further).

Assumption 2 : $\rho_c < \frac{1}{p(1+r^*)} = \rho_b$

Assumption 2 illustrates that the discounting factor of the cooperative is lower than the discounting factor of the bank (hereafter ρ_b). This is consistent with the common wisdom of a short investment horizon of cooperatives.

In perfect information, the cooperative's objective is to find the optimal level of debt and investment (d^*, i^*) that maximizes the discounted profit subject to its financial constraint (FC). This aims at maximizing the sum of the short term utility and the discounted long term utility less the discounted cost of the debt, provided that the cooperative cannot invest more than the monetary amount raised as debt plus the exogenous short term gain G, i.e. the financial constraint. Thus, the cooperative's program corresponds to:

$$\begin{cases} \max_{\{d,i\}} \;\; \Pi(d,i) = U(d,i,G) + \rho_c V(i) - \rho_c p(1+r^*)d \\ \;\; s.t. \\ (FC) : G + d \geq i \end{cases} \tag{2}$$

The optimal amount of investment and debt are solutions of the following system:

$$\begin{cases} U_d(d^*\,,\, i) \; - \rho_c p(1+r^*) = 0 \\ U_i(d\,,\, i^*) + \rho_c V_i(i^*) = 0 \end{cases} \tag{3}$$

By assumption 1, the optimal level of investment is solution of the following equation:

$$p(1+r^*) = V_i(i^*) \tag{4}$$

As we are in perfect information, the bank can observe the optimal level of investment. Then the bank as no incentives to provide a debt higher than the optimal level of investment. Indeed, in this case the marginal return of overinvestment would be lower than the cost of debt. Moreover, the cooperative has always interest to capture its internal fund G, for members short term benefit. Indeed, the profit when cooperatives capture G is always higher than the profit when cooperatives invest G. This leads to the following proposition.

[1] We use indexed variable in the function U to refer to the first partial derivative of the function U in relation with this variable. To this end, assumption 1 means that $U_d(d,i) = \frac{\delta U(d,i)}{\delta d} = -\frac{\delta U(d,i)}{\delta i} = -U_i(d,i)$.

Proposition 1 *In perfect information, when the discounted profit maximizer cooperative can raise debt to finance investment, it trades off between the marginal cost of the debt and the long run marginal utility of one dollar invested. This trade off (i) does not depend on the discounting factor of the cooperative, and (ii) the cooperative members use internal funds for their own compensation.*

Proof:

(i) ρ_C does not appear in the trade off illustrated in result (4).

(ii) Let's denote by Π^{cap} the profit when cooperatives capture G and Π^{inv} the profit when cooperatives invest G. Then,

$\Pi^{cap} = U(G) + \rho_c(V(i^*) - i^*p(1+r^*))$
$\Pi^{inv} = U(0) + \rho_c(V(i^*) - (i^* - G)p(1+r^*))$
As $U(G) = G$, $U(0) = 0$ and because of assumption (2), $\Pi^{cap} > \Pi^{inv}$ is always true.

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A key-result of the proposition 1 is that investment depends exclusively on the cost of debt and not on the discounting factor of the cooperative. In other words, the cost of debt has more impact on the investment behavior than the investment horizon of cooperatives. This is interesting as the possible underinvestment of cooperatives are often explained by the supposed short investment horizon of cooperatives. In our setting, in addition to the prospect of value creation, the bank and cooperative relationship is the key-determinant of the investment behavior. It follows from assumption 2 that the level of investment of the benchmark case is always lower than the level of investment for the cooperative financed by debt. This can explain some forms of overinvestment as observed during [...] by [authors ...]. Figure 1 illustrates this result. Furthermore, the second part of proposition 1 implies $d^* = i^*$ and the cooperative uses the internal fund G as extra compensation for cooperative members.

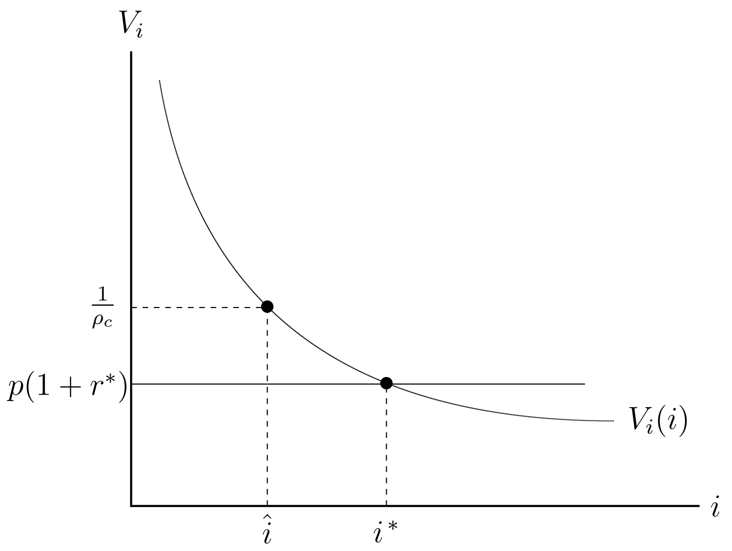

Figure 1. The optimal level of investment in perfect information.

Here we deal with the optimal solution of a cooperative in perfect information. In the next section we consider that coexists different types of cooperatives that the bank cannot distinguish.

2.3 Financing different types of coops in perfect information

In the following, we consider that cooperatives can differ in their probability of success p. For modeling purpose we here consider the simple case where two types of cooperative coexist. The riskiest cooperatives (indexed under bar) are the bad type and the safest (indexed upper bar) the good one ($\underline{p} < \overline{p}$). The bank is able to distinguish among different types of cooperatives. We also assume that default implies non-contractible costs related to the cost of collateral recovery, reputation and other fees related to default processes. Therefore the bank applies a cost of debt always higher for the riskiest cooperatives than for safest ($\underline{r}^* > \overline{r}^*$). Following the previous consideration, we assume that:

Assumption 3 *:* $\overline{p}(1+\overline{r}^*) < \underline{p}(1+\underline{r}^*)$

As a consequence of assumption 3 and of result (4), the higher cost of debt for the riskiest cooperatives, implies that they invest less than safest ones at the optimum (see result (5) and Figure 2).

$$\begin{cases} \underline{p}(1+\underline{r}^*) = V_i(\underline{i}^*) \\ \overline{p}(1+\overline{r}^*) = V_i(\overline{i}^*) \end{cases} \tag{5}$$

As consequences of proposition 1, $\underline{d}^* = \underline{i}^* < \overline{d}^* = \overline{i}^*$ and both types of cooperatives capture G for the short term benefit of cooperative members (which is the same for both types).

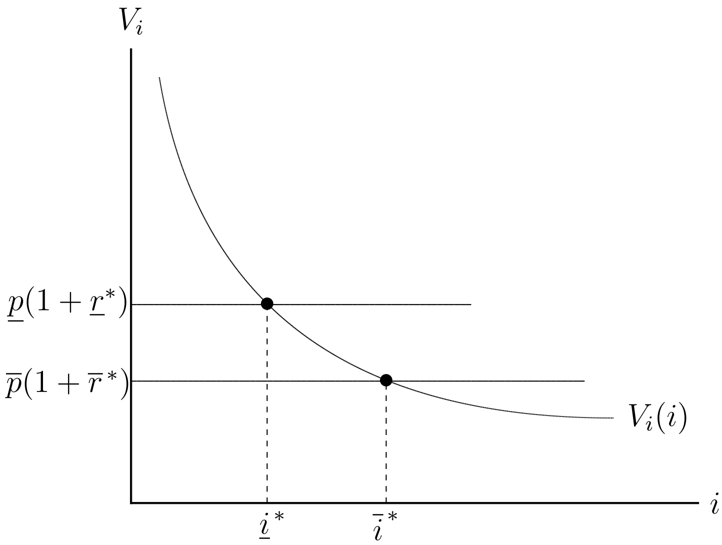

Figure 2. The optimal level of investment with different types in perfect information.

For now, we have supposed perfect and complete information. If types are not publicly observable by the bank (asymmetric information), imitation behavior can arise. It comes that riskiest cooperatives have interest to mimic the safest ones for two different reasons, to benefit from the value created by a higher investment and a lower cost of debt. Then the bank as to behave according to the observable information, i.e. implement the optimal incentive contract when signalling does not occur. In the following, we consider different cases of information asymmetry.

2.4 Financing different types of coops with signaling investment

Let's assume that two types of cooperatives coexist. The cooperative can be either risky (respectively safe) with probability ν (respectively $(1-\nu)$). Let's consider the following asymmetric information case: the bank does not observe the probability of success and so cannot distinguish the different types of cooperatives (asymmetric information); each type of cooperative knows the interest rate paid by others but not the investment behavior nor the level of requested debt (incomplete information). In this setting, the timing of events is as follows:

1. Nature draws p in the set $\{\underline{p}\,;\,\overline{p}\}$ with probability ν and $1-\nu$.
2. Cooperatives observe p and announce their type to the bank.
3. The bank proposes r^S in the set $\{\underline{r}^S\,;\,\overline{r}^S\}$ with $\underline{r}^S > \overline{r}^S$.
4. Cooperatives choose an interest rate r^S and decide the optimal level of investment i^S and the level of debt d^S related to their type.
5. The bank can readjust their interest rate proposal.
6. Cooperatives review their level of investment and debt according to the terms proposed by the bank.

The following proposition describes the optimal solutions in this case.

Proposition 2 *Let $[(\underline{i}^S, \underline{d}^S, \underline{r}^S); (\overline{i}^S, \overline{d}^S, \overline{r}^S)]$ be the optimal solution in asymmetric and incomplete information for both types of cooperatives, then signalling is possible and investment, debt and interest rate are the solution of perfect information:*

(i) $\underline{i}^S = \underline{i}^* = \underline{d}^*$

(ii) $\overline{i}^S = \overline{i}^* = \overline{d}^*$

(iii) $\underline{r}^S = \underline{r}^*$

(iv) $\overline{r}^S = \overline{r}^*$

Proof:
The $\underline{p}$-coops will claim a low default likelihood (high probability of success), equal to those of the (safe) $\overline{p}$-coops in order to enjoy a lower interest rate. As a consequence, the bank will propose the interest rate of safe cooperatives to risky ones. But as their likelihood

of default is higher, the total level of expected repayment is lower in comparison to safe cooperatives. Then,

$$\underline{p}(1+\overline{r}^S) < \overline{p}(1+\overline{r}^S) \tag{6}$$

As a consequence of result (4) and result (6), the optimal levels of investment for both types , $\underline{i}^S$ and $\overline{i}^S$ are such that:

$$V_i(\underline{i}^S) < V_i(\overline{i}^*) = V_i(\overline{i}^S) \tag{7}$$

As the function V is increasing and concave, then this provides risky cooperatives an incentive to invest more than safe cooperatives which do not have any incentive to modify their behavior (the long term marginal value of investment is still equal to the marginal cost of debt). Thus,

$$\underline{i}^S > \overline{i}^* = \overline{i}^S \tag{8}$$

However, as this is directly observable by the bank, this will act as a signal and the bank will provide them with the debt and interest rate related to their level of risk. In this context, the bank does not need to design an incentive contract to screen among different types, and the optimal solution of perfect information holds.

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In the following section, we still assume asymmetric information between the bank and cooperatives, but consider the case of complete information between cooperatives. Then, risky cooperatives can mimic the behavior of safe ones. In this case, the bank has to design a menu of contract to provide the incentives enabling them to break even.

3 Financing coops with incentive contracts

When cooperatives have complete information about the investment behavior of others, they are able to perfectly mimic each others. If they need to, they can announce the level of risk (imperfectly observable by the bank) to obtain the favorable interest rate and asking for the level of investment which prevents to be identified by the bank. This is a standard principal-agent issue. To counteract information asymmetries, the bank (the principal) have to build a menu of contract to screen among types of cooperatives (the agent).

Interest rate only does not enable screening because all types of cooperative will choose the lowest interest rate and announce the level of investment related to this interest rate (complete information between coops). In the context proposed here, the cash related to debt is a determinant of current payment to cooperative members and so, of short-term utility. As the amount of internal funds G is common knowledge, the bank will ask for a contribution θG, with $\theta \in [0, 1]$ so as to get an additional tool for contracting. The contribution θ is costly for cooperatives since it prevents to capture all the internal fund for short term compensation (see proof of proposition 1). On the contrary the bank benefits from a higher level of θ since it allows to increase the level of collateral recovered in case of cooperatives default (see the expected gain EU_b of the bank in the following section). In this setting, the timing of events is as follows:

1. Nature draws p in the set $\{\underline{p}\,;\,\overline{p}\}$ with probability ν and $1-\nu$.
2. Cooperatives observe p and announce their type to the bank.
3. The bank proposes a menu of contract $[(\underline{r},\underline{\theta});(\overline{r},\overline{\theta})]$ if such a contract exists.
4. Cooperatives announce the level of investment i and the level of debt d related to the contract that they choose, or recover their *status quo* value $\Pi^\star$ if they decide not to contract with the bank.
5. The bank implements the contract if agreed by cooperatives.

In the following section, let's consider the case of perfect information when the probability of success p is perfectly observable and when the bank implements a contract.

3.1 The first best solutions

In perfect information, the bank builds a contract with a level of interest rate r and an amount of cash θG as a financial contribution (with $\theta \in [0,1]$). Moreover the bank can recover the tangible assets ki as a collateral in case of default. Where $k \in [0,1]$, represents the part of tangible investment. The expected gain $EU_b(r,\theta)$ of the bank is the weighted sum of the discounted repayment recovered in case of success and the discounted collateral in case of default (ρ_b represents the discounting factor of the bank). Then, the financial constraint of the bank when it builds a contract and can perfectly observe types is:

$$EU_b(r,\theta) = \rho_b\big(p(1+r)d + (1-p)k(d+\theta G)\big) \geq d$$

In the case of contracting with the bank, the cooperative profit function depends also on θ and can be formalized as follows:

$$\Pi(d,i,r,\theta) = U(d,i,\theta) + \rho_c V(i) - \rho_c p(1+r)d$$

The cooperative will accept the contract only if the profit with investment is higher than the *status quo* profit $\Pi^\star$ obtained without investment. So we can write the participation constraint of the cooperative as:

$$\Pi(d,i,r,\theta) \geq \Pi^\star \ \ (PC)$$

As a consequence of the requirement of a financial contribution by the bank, the available amount of cash in the short term $C = d - i + (1-\theta)G$. As the short term utility function U is quasi-concave in C, it follows that $U_\theta(d,i,\theta) < 0$. Thus, financial contribution is costly for cooperatives. In perfect information, the bank must find a contract maximizing its objective function subject to the participation constraint of the cooperative. This leads to find the solution (indexed FB) of the following program:

$$\begin{cases} \max_{\{r,\theta\}} \quad EU_b(r,\theta) \\ \quad s.t. \\ (PC) : \Pi(d,i,r,\theta) \geq \Pi^\star \end{cases} \tag{9}$$

The bank may find the contract that binds the participation constraint of the cooperative. Thus we can rewrite the maximization program of the bank in term of the financial contribution θ. The first order conditions leads to the following first best solution for the financial contribution. θ^{FB} is such that:

$$U_{\theta^{FB}}(d,i,\theta^{FB}) = -\rho_c(1-p)kG \tag{10}$$

The first best level of theta is such that the marginal disutility ($U_\theta < 0$) of the contribution in the short run (left part of result (10)), is equal to the discounted value related to the collateral effect of the contribution (right part of result (10)). Indeed, to finance tangible assets with internal funds, increases the value received by the bank in case of bankruptcy. The first best level of theta is such that this supplement of value for the bank is equal to the marginal cost for the cooperative. Result (10) also relates financial contribution and asset tangibility (collateral). We obtain the first best interest rate by replacing the solution of (10) into the participation constraint of the cooperative. Thus, this leads to:

$$(1+r^{FB}) = \frac{U(d,i,\theta^{FB}) + \rho_c V(i) - \Pi^\star}{\rho_c p d} \tag{11}$$

The bank considers an interest rate which binds the participation constraint of the cooperative. So the first best interest rate is such that the bank benefits from the profit achieved by the cooperative investment (minus the opportunity cost of the cooperative , i.e. the *status quo* value). This is expected as the bank is the principal. In the previous case of perfect information or when signalling occurs the optimal interest rate is determined by the probability of default only. Information asymmetries leads the bank to take into account the profitability of the project to balance with the information and contracting costs. This implies monitoring[2].

In the next section, we focus on the second-best solutions, given that information asymmetry requires a contract with incentives to deter the risky cooperatives to mimic the safe ones.

3.2 The Second Best solutions

The bank builds a contract with a level of interest rate r and a financial contribution determined by θ in order to screen among good (in proportion $(1-\nu)$, the safe cooperatives) and bad types (in proportion ν, the risky cooperatives). In comparison with the expected utility of the previous section, the bank now takes in account the fact that two types coexist. The expected gain of the bank EU_b depends now on the interest rate, on the financial contribution and on the probability of success for both types as well as the proportion of

[2] We here assume that the cost of monitoring is negligible.

each type among cooperatives and the collateralizable part of investment. In other word, the expected gain $EU_b(\underline{r},\underline{\theta},\underline{p},\overline{r},\overline{\theta},\overline{p})$ of the bank is the weighted sum of the discounted repayment recovered in case of success and the discounted collateral in case of default weighted by the proportion of both types:

$$EU_b(\underline{r},\underline{\theta},\underline{p},\overline{r},\overline{\theta},\overline{p}) = \rho_b\Big(\nu\big(\underline{p}(1+\underline{r})\underline{d}+(1-\underline{p})k(\underline{d}+\underline{\theta}G)\big)+(1-\nu)\big(\overline{p}(1+\overline{r})\overline{d}+(1-\overline{p})k(\overline{d}+\overline{\theta}G)\big)\Big)$$

The financial constraint of the bank when it builds a contract and cannot perfectly observe types is such that the expected gain is at least over the weighted sum of debt contracted with both types:

$$EU_b(\underline{r},\underline{\theta},\underline{p},\overline{r},\overline{\theta},\overline{p}) \geq \nu\underline{d} + (1-\nu)\overline{d}$$

In the case of contracting with the bank, the profit function of cooperatives which behave according to their type is $\Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\underline{p}}$ for $\underline{p}$-coops (respectively $\Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\overline{p}}$ for $\overline{p}$-coops). It can be formalized as follows:

$$\begin{cases} \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\underline{p}} = U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c\underline{p}(1+\underline{r})\underline{d} \\ \\ \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\overline{p}} = U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c\overline{p}(1+\overline{r})\overline{d} \end{cases} \tag{12}$$

The bank issue is to design a contract providing the incentives for $\underline{p}$-coop (respectively $\overline{p}$-coop) to choose the contract intended to them. To this aim, the incentive constraint $\underline{IC}$ for $\underline{p}$-coop (respectively $\overline{IC}$ for $\overline{p}$-coop) may imply that the profit of $\underline{p}$-coop (respectively $\overline{p}$-coop) is always higher when choosing the $[(\underline{r},\underline{\theta})]$ contract (respectively the $[(\overline{r},\overline{\theta})]$ contract) than the $[(\overline{r},\overline{\theta})]$ contract (respectively the $[(\underline{r},\underline{\theta})]$ contract). This leads to:

$$\begin{cases} \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\underline{p}} \geq \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\underline{p}} \\ \\ \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\overline{p}} \geq \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\overline{p}} \end{cases} \tag{13}$$

The bank program is to find the optimal contract for each type that maximizes its expected gain subject to participation constraints ($\underline{PC}$ and $\overline{PC}$) and incentive constraints ($\underline{IC}$ and $\overline{IC}$) for both types of cooperatives:

$$\begin{cases} \max_{\{(\underline{r},\underline{\theta});(\overline{r},\overline{\theta})\}} \; EU_b(\underline{r},\underline{\theta},\underline{p},\overline{r},\overline{\theta},\overline{p}) \\ \;s.t. \\ (\underline{PC}) : \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\underline{p}} \geq \Pi^\star \\ \\ (\overline{PC}) : \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\overline{p}} \geq \Pi^\star \\ \\ (\underline{IC}) : \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\underline{p}} \geq \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\underline{p}} \\ \\ (\overline{IC}) : \Pi(\overline{d},\overline{i},\overline{r},\overline{\theta})\big|_{p=\overline{p}} \geq \Pi(\underline{d},\underline{i},\underline{r},\underline{\theta})|_{p=\overline{p}} \end{cases} \tag{14}$$

The $\overline{PC}$ constraint is always satisfied with strict equality as the bank will implement a program such as safe cooperatives can always invest. The participation constraint for the good type is binding leads to the following interest rate for the $\overline{p}$-coop:

$$(1+\overline{r}) = \frac{U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \Pi^\star}{\rho_c \overline{p}\overline{d}} \tag{15}$$

The $\overline{IC}$ constraint is also always satisfied. In our setting, the safe cooperatives have never interest to mimic the risky ones. The $\underline{IC}$ constraint is binding as the bank seeks to provide the right incentives to prevent risky cooperatives from mimicking safe ones. The $\underline{PC}$ constraint is not necessarily satisfied: some contracts can lead the risky cooperatives to prefer to not invest than contracting debt with unfavourable terms. In our setting both incentive constraints are such that:

$$\begin{cases} (\underline{IC}) : U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c \underline{p}(1+\underline{r})\underline{d} = U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c \underline{p}(1+\overline{r})\overline{d} \\ \\ (\overline{IC}) : U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c \overline{p}(1+\overline{r})\overline{d} \geq U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c \overline{p}(1+\underline{r})\underline{d} \end{cases} \tag{16}$$

The $\underline{IC}$ constraint is binding sets the interest rate for the $\underline{p}$-coop such that:

$$(1+\underline{r}) = \frac{U(\underline{d},\underline{i},\underline{\theta}) - U(\overline{d},\overline{i},\overline{\theta})}{\rho_c \underline{p}\underline{d}} + \frac{U(\overline{d},\overline{i},\overline{\theta})}{\rho_c \overline{p}\underline{d}} + \frac{V(\underline{i}) - V(\overline{i})}{\underline{p}\underline{d}} + \frac{\rho_c V(\overline{i}) - \Pi^\star}{\rho_c \overline{p}\underline{d}} \tag{17}$$

We now use (15) and (17) to rewrite the maximization program of the bank in terms of the financial contribution for both types and derive the FOCs to compute the second best solutions:

$$\begin{cases} U_{\underline{\theta}^{SB}}(\underline{d},\underline{i},\underline{\theta}^{SB}) + \rho_c(1-\underline{p})kG = 0 \\ U_{\overline{\theta}^{SB}}(\overline{d},\overline{i},\overline{\theta}^{SB}) + \rho_c(1-\overline{p})kG = \left(\frac{\nu}{1-\nu}\right)R(\overline{\theta}^{SB}) \end{cases} \tag{18}$$

Where $R(\overline{\theta})$ corresponds to the informational rent. This one can be formalized as follow:

$$R(\overline{\theta}) = \left(\frac{\overline{p}-\underline{p}}{\overline{p}}\right)U_{\overline{\theta}}(\overline{d},\overline{i},\overline{\theta}) \tag{19}$$

In the equation (18), the first FOC shows that there is no distortion at the bottom for $\underline{\theta}$. In other words, the second best financial contribution $\underline{\theta}^{SB}$ is equal to the first best financial contribution $\underline{\theta}^{FB}$ for the riskier $\underline{p}$-coop. The second FOC shows that there is a distortion for $\overline{\theta}$. As the right-hand side of the equation is likely to be positive , and $U(.)$ decreasing and concave in θ, the second best financial contribution $\overline{\theta}^{SB}$ is lower than the first best financial contribution $\overline{\theta}^{FB}$. Because of the condition for binding $\underline{IC}$, the short term utility provided by the bank to safe cooperatives by a decrease of the financial contribution requirement corresponds to a decrease of the interest rate paid by risky cooperatives. Say differently, the bank decreases the interest rate for riskier cooperatives so as to reduce the incentive of imitation behavior. As such, this represents the informational rent paid to the riskier cooperatives. We can now formulate the following proposition to characterize the contract between the bank and the cooperative:

Proposition 3 *Let* $[(\underline{r}^{FB}, \underline{\theta}^{FB}), (\overline{r}^{FB}, \overline{\theta}^{FB})]$ *be the solution of the complete information program. Let* $[(\underline{r}^{SB}, \underline{\theta}^{SB}), (\overline{r}^{SB}, \overline{\theta}^{SB})]$ *be the solution of the asymmetric information program. Then, the bank financing cooperative first best and second best contracts are such that:*

(i) $\underline{\theta}^{FB} = \underline{\theta}^{SB}$*, there is no distortion at the bottom for the level of the financial contribution.*

(ii) $\overline{\theta}^{FB} > \overline{\theta}^{SB}$*, the second best contribution required to the safe cooperatives is lower than the first best one. This is a way to compensate the higher than first best interest rate due to the payment of the informational rent.*

(iii) $\underline{r}^{FB} > \underline{r}^{SB}$*, the second best interest rate for risky cooperatives is lower than the first best one. This is the incentive to prevent them from mimicking the safe cooperatives.*

(iv) $\overline{r}^{FB} < \overline{r}^{SB}$*, the second best interest rate for safe cooperatives is higher than the first best one. Safe cooperatives have to pay the informational rent for the risky cooperatives, but it is compensated by a lower contribution in internal finance for investment.*

Figures 2 and 3 describe the first best and second best contracts in two different situations, when the financial contribution asked by the bank is paid by the risky cooperatives and when it reaches its maximum (corner solution). In this case, the interest rate paid by the risky cooperatives is much higher. As a result, safe cooperatives should underinvest because of a higher than first best interest rate, but they benefit from a larger slack in the use of internal funds. This can be a key-factor for obtaining the commitment of cooperative members in the new project. Risky cooperatives benefit from a low interest rates, which can imply overinvestment. However, the bank does not provide any slack in the use of internal funds.

As such, our setting, which is based on cooperative finance features, show that we should observe the co-existence of safe cooperatives which can manage the payment of cooperative members via the use of their internal funds, but underinvest because of a high cost of debt, and risky cooperatives which have to use their internal funds to invest (in the detriment of the short-run compensation of cooperative members) but overinvest because of lower interest rates. Other results can be drawn from the model by studying the effects of value creation (the function V), asset tangibility and the proportion of risky versus safe cooperatives.

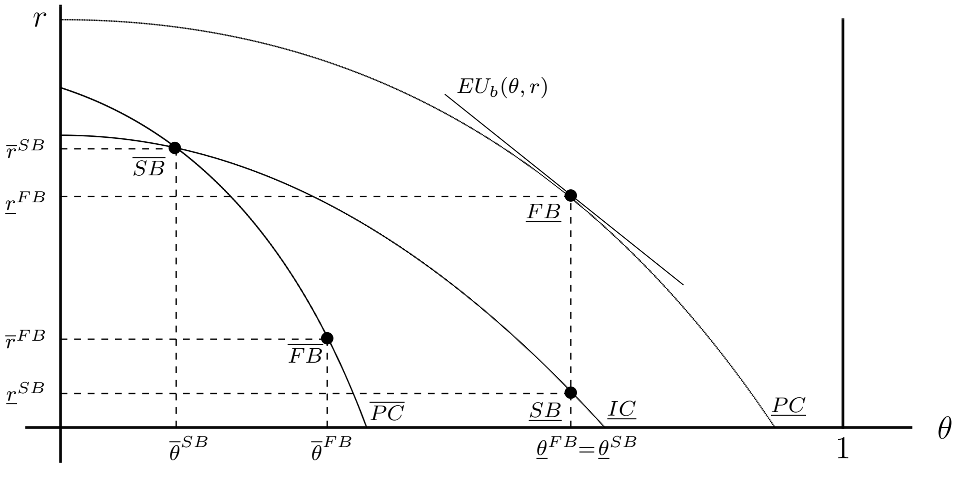

Figure 3. First best and second best contracts.

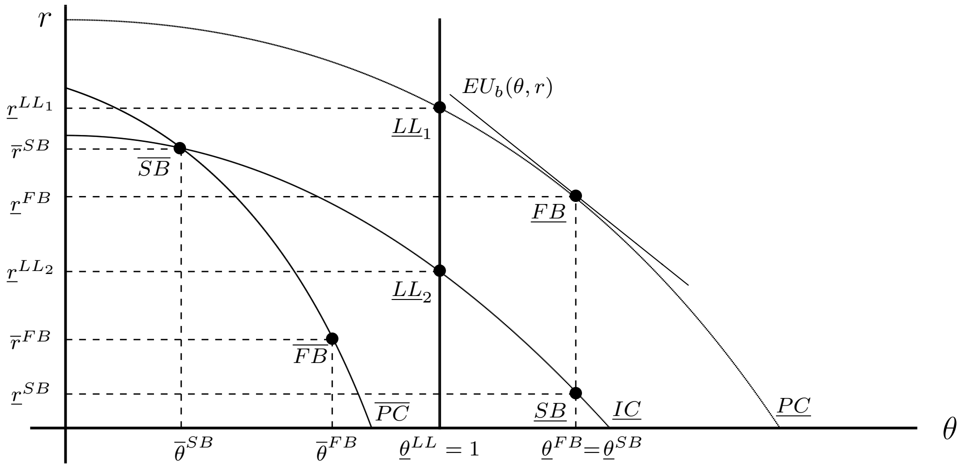

Figure 4. First best and second best contracts with corner solution for $\underline{p}$-type.

4 Conclusion

Our model shows that the bank can deal with information asymmetry by reducing the interest rate of risky cooperatives to reduce the incentive to mimic the safe ones. These latter pay a higher than optimal interest rates but benefit from a lower required amount of internal funds to finance investment, providing them with a slack to manage the payment to cooperative members. As such, it comes that the level of investment of safe cooperatives is lowered by the upper level of interest rates, but credit availability gives them the ability to manage distribution policy toward cooperative members. This can be a critical element to gain the commitment of cooperative members in the investment project. Therefore, bank relationship plays an important role in the lifecycle of cooperatives.

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